PROCEEDINGS OF A WORKSHOP ON CANADIAN WETLANDS

COMPTE-RENDU D'UN ATELIER SUR LES TERRES HUMIDES DU CANADA

Ecological Land Classification Series, No. 12

Série de la classification écologique du territoire, No 12

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A meeting of the National Wetlands Working Group, Saskatoon, Saskatchewan 11-13 June 1979

COMPTE-RENDU D'UN ATELIER SUR LES TERRES HUMIDES DU CANADA

Une réunion du Groupe de travail des terres humides, Saskatoon, Saskatchewan 11-13 juin 1979

Compiled and Edited by
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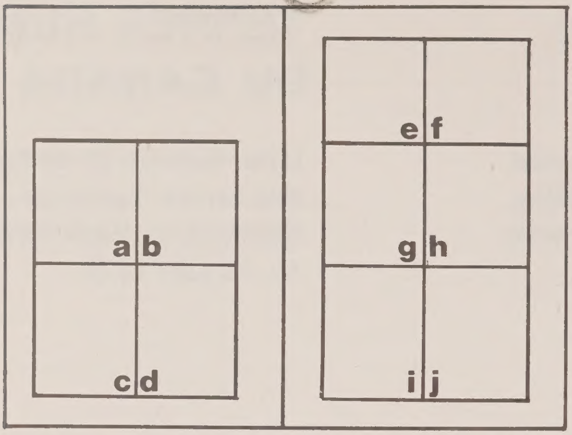

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FOREWORD

F.C. Pollett
Chairman
Wetlands Working Group

This report is the first published through the National Wetlands Working Group of the CCELC. The Working Group was initiated in 1975 following the first meeting of the CCELC in Petawawa. In later discussions on the goals of the Group it was decided that the long term goal should be "to develop a healthy national perspective on the wetland resource and its potential uses". Other more immediate goals were:

- to improve the original wetland classification prepared by the Subcommittee on Organic Terrain Classification;
- to establish a registry (open file form) of wetland types with the purpose of maintaining some uniformity for the classification system;
- to prepare a library of illustrations (i.g. selected air-photos, slides, sketches) of wetlands that might be used for educational, training and liaison activities;
- to identify our user groups and to ascertain how our data are being used;
- to hold workshops for the Working Group;
- another goal was to establish pilot projects within regions to test the applicability of the proposed wetland classification - this goal would be left to regional initiatives.

With this framework, recruitment of members was undertaken in 1977-78. The first workshop of the Group was held in Newfoundland in October 1977. This experience proved valuable because two days were spent undertaking field work. It was agreed that future workshops would include similar field excursions. At the workshop a number of work activities wre approved. These included the production of a book on the "Wetlands of Canada"; the sponsoring of a national symposium; development of a refined wetland classification for Canada; development of registry of wetland types in Canada, and the holding of Group Workshops in different peatland regions.

We have been successful in upgrading the wetland classification and we have established the methdology and now have in place the beginnings of a national wetland registry. We have also managed to introduce

AVANT-PROPOS

F.C. Pollett
Président
Groupe de travail des terres humides.

Voici le premier rapport publié par l'entremise du Groupe national de travail des terres humides issu du Comité canadien de la classification écologique du territoire (CCCET). Le groupe de travail a été formé en 1976, après la première réunin du CCCET, à Petawawa. Au cours d'entretiens subséquents sur les buts du groupe, il a été décidé que l'objectif à long terme consisterait "à élaborer une perspective nationale saine de la ressource que représentent les terres humides et de ses utilisations possibles". D'autres objectifs plus immédiats ont été fixés:

- améliorer la classification originale des terres humides établie par le Sous-comité de la classification organique du territoire;
- établir un répertoire (style dossier courant) des types de terres humides, en vue de maintenir une certaine uniformité dans le système de classification;
- constituer une collection d'illustrations (Photographies aériennes, diapositives, croquis) de terres humides pouvant servir à des fins d'enseignement, de formation et de liaison;
- déterminer les groupes d'usagers ainsi que la façon dont nos données sont utilisées;
- organiser des ateliers pour le groupe d'étude
- établir des projets-pilotes dans les régions afin de vérifier la pertinence de la classification proposée des terres humides. (Cet objectif serait laissé à l'initiative des régions).

A partir de cette structure, on a entrepris le recrutement de membres en 1977-1978. Le premier atelier du groupe a eu lieu à Terre-Neuve, en octobre 1977. L'expérience s'est révélée profitable car deux jours ont été consacrés au travail sur le terrain. Il a été convenu que les prochains ateliers comporteraient de telles excursions. Lors de l'atelier, plusieurs activités ont été approuvées. Il s'agit de la production d'un livre sur "les terres humides du Canada"; du parrainage d'un symposium national; de l'élaboration d'une classification améliorée de terres humides au Canada; de l'établissement d'un répertoire des types de terres humides au Canada et de l'organisation d'ateliers de travail dans diverses régions tourbeuses.

Nous avons réussi à améliorer la classification

members to different wetland regions through workshop field trips. These proceedings are based on our meeting in Saskatoon. For many of us, it afforded the first chance to see Prairie marshes both on the ground and, courtesy of Ducks Unlimited, from the air.

Our challenge is to continue to upgrade the work now underway and to add new work. Hopefully, our next challenge will involve the lifting of our wetlands book from the back burner and giving it a priority until its publication. There is not doubt about the need for a book to enhance public awareness of Canadian Wetlands.

The wetlands of Canada occupy some 12-15% of the land area. Yet there is very little material available on wetlands for use by a broad-based audience. The opportunity to meet this need can and should be taken by the NWWG through the production of a generalized ecological-based book on bog, fen, marsh and other associated wetlands. The text will likely be aimed at a high school - first year university level. Hopefully, it will be of such a nature that it would have appeal to the public at large. The text would describe and profusely illustrate the ecological diversity of wetlands from east to west and from the arctic to temperate zones.

The National Wetlands Working Group undertakes its activities with no funding other than that needed for offsetting some workshop expenses. It is work supported by the members and the agencies they serve. This fact attests to the interest of the members and their desire to undertake work related to this, too often neglected, national resource.

des terres humides et en avons établi la méthodologie, si bien que la base d'un registre national des terres humides est maintenant en place. Nous avons également initié nos membres à diverses zones humides, grâce aux expéditions organisées dans le cadre des ateliers. Le présent compte rendu porte sur la réunion que nous avons tenue à Saskatoon. Pour bon nombre d'entre nous, c'était la première occasion de voir les marais des Prairies, tant au niveau du sol que du haut des airs, grâce à Canards Illimités.

Il nous reste donc à continuer d'améliorer le travail en cours et à entreprendre de nouvelle activités. Espérons que notre prochain défi consistera à accorder une plus grande priorité à notre livre sur les terres humides, jusqu'à sa publication. Il ne fait aucun doute qu'un tel livre s'impose pour sensibiliser le public à l'égard des terres du Canada.

Les terres humides occupent 12 à 15 % du territoire canadien. Malgré tout, il existe sur ce sujet très peu de documentation destinée au public. Le groupe de travail peut et doit saisir l'occasion de répondre à ce besoin par la production d'un ouvrage général, de nature écologique, portant sur les tourbières, les marécages, les marais et autres terres humides. L'ouvrage sera probablement orienté vers les étudiants du niveau secondaire et de première année universitaire. Il est souhaitable que sa présentation sache intéresser également le grand public. La diversité écologique des terres humides, de l'est à l'ouest et de la zone arctique aux régions tempérées, y sera décrite et abondamment illustrée.

Le groupe de travail entreprend ses activités sans avoir reçu d'autres fonds que ceux qui lui sont nécessaires pour compenser certaines dépenses occasionnées par la tenue d'ateliers. Ses travaux sont défrayés par les membres et les organismes desservis. Ce fait témoigne de l'intérêt des membres et de leur désir d'entreprendre une oeuvre valable à l'endroit de cette ressource nationale trop souvent négligé

F.C. Pollett

AN OUTLINE OF THE WETLAND REGIONS OF CANADA

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ABSTRACT

Sixteen wetland regions were identified on the basis of wetland development throughout Canada. Wetland districts were identified in some regions, according to distribution and relative abundance of certain kinds of wetlands. A map of wetland distribution in Canada was compiled. This report is based largely on the work of the National Wetlands Working Group, and was prepared as a part of a comprehensive report on the wetlands of Canada.

RÉSUMÉ

Au Canada, seize régions de terres mouillées ont été identifiées d'après l'extension des terres mouillées. Dans certaines de ces régions, des districts ont été délimités selon la répartition et l'abondance relative de certains types de terres mouillées. Une carte de la répartition a été établie. Ce rapport est fondé en grande partie sur les travaux du groupe de travail national sur les terres mouillées et fait partie d'un rapport détaillé et complet sur les terres mouillées du Canada.

INTRODUCTION

The National Wetlands Working Group began assembling a comprehensive report on the wetlands of Canada. As a first step in this direction, the wetland regions were to be determined and characterized. Such regions, based on ecological principles, would serve as a framework for the more detailed discussion of Canada's wetlands.

In previous attempts (Zoltai et al 1973, Zoltai and Tarnocai 1976, Zoltai 1976) the concept of wetland regions was presented, but not elaborated. When the initial map was examined by the Wetlands Working Group, the number, character and boundaries of the various wetland regions were found to be inadequate. This has been corrected by a series of draft maps and descriptions. The comments by the Wetlands Working Group led to new ideas, namely the recognition of wetland districts, and the representation of wetland distribution. The present paper is an integration of the information provided by the Wetlands Working Group into a cohesive report.

DISTRIBUTION

Wetlands, as used in this paper, are defined as areas where wet soils are prevalent, having a water table near or above the mineral soil (Zoltai et al 1973) for the most part of the thawed season, supporting a hydrophylic vegetation. Wetlands include peatlands formed by the accumulation of remains of hydrophylic vegetation. They also include areas that are influenced by excess water, but where, for climatic, edaphic, or biotic reasons, peat is not produced or preserved. Shallow open water, generally less than 2 m deep, dominated by emergent vegetation is also included. This type of wetland is especially important in semi-arid areas where the depressions, called potholes or sloughs, may fill up with water in the spring, but are usually partially dry by the end of summer. The definition does not include areas that may become temporarily flooded, but remain relatively well drained for most of the growing season.

The extent or distribution of wetlands in Canada was not determined with any degree of precision. Various estimates are available of the area of peatlands; these vary from a low of 5.9×10^6 ha (Coupal 1972) to a maximum of 130×10^6 ha (Radforth 1961). Other estimates are 9.6×10^6 ha of peatlands (Tibbetts 1968) and 121×10^6 ha of organic soils capable of being cultivated (Leahey 1961). The wide ranges of these estimates reflect the different criteria used to obtain them and show a lack of general basic information.

For the present study, data were collected from different sources, such as published reports (Ketcheson and Jeglum 1972, Korpijaakko 1975), maps of Canada Soil Survey and Canada Land Inventory in the developed areas and surficial deposit maps of the Geological Survey of Canada in the north. This information covered about half of Canada south of the arctic regions. For the rest of Canada, estimates were obtained from knowledgeable resource managers. The resulting map (Figure 1) is still only an estimate, although it is probably more accurate than previous estimates. On this basis, the total area of wetlands in Canada is about 170 x 10^6 ha, or 18% of Canada's land surface. Peatlands are the most common wetlands. It is estimated that about 90% of the wetlands are covered by peat over 50 cm in thickness.

WETLAND REGIONS

Regional differences in the development of wetlands are readily apparent in Canada. Some of these differences relate to the development of certain kinds of wetlands, while others relate to the distribution or abundance of wetlands. Although distribution is often influenced by physiography, the developmental trends and the establishment of specific kinds of wetlands can be attributed to climate-related regionalization.

Figure 1: Distribution of Wetlands in Canada, Expressed as Percent (%) of Total Land Surface

Wetlands are dynamic ecosystems where an interaction of the biotic and abiotic environment produces specific physical and biological conditions. Various factors, such as water quantity and quality, peat formation, vegetation, organisms, etc., are continually interacting and reacting to changes brought about by other factors. These interactions take place through time under climatic conditions that may change, emphasizing the dynamic nature of wetlands, where different wetlands develop under different conditions. If the developing wetland is in equilibrium with its environment as modified by the wetland itself, very few changes will occur. On the other hand, if the developing wetland alters its own environment, or if the environment changes because of external natural or artificial causes, certain changes will take place in the development of the wetland. It follows that surface conditions reflect the present status which is but a slice in time of what may be a steady state or a transitional period. An understanding of wetland dynamics is therefore essential in a rational study and classification of wetlands.

Regional studies in Europe and Asia showed that broad geographic regions have characteristic wetlands. In Europe, nine zones were identified (Bellamy 1972), three in Finland, with several subzones (Ruuhijärvi 1970), ten in the USSR (Matveev et al 1968), with seven in West Siberia (Neishtadt 1977). In Canada similar regionalization of wetland development was observed, generally along a north-south temperature gradient and an east-west precipitation gradient. Sixteen regions were recognized, divided among six zones (Figure 2).

The wetland regions are based on the developmental trends of wetlands within the regions. Abundance is not a determining factor, although it may be one of the characteristics of the region. Subdivisions of the regions may be necessary if a part of the region is somewhat different from the other parts of the region, but the differences are not great enough to recognize it as a different region. Such wetland districts resemble the wetland regions, but are different in the distribution of peatlands, or in the relative abundance of various wetlands. A few wetland districts are identified on the map (Figure 2).

Broad vegetation regions, based mainly on dryland vegetation, resemble the wetland regions in a general sense. This prompted Stanek (1977) to delineate the muskeg regions of Canada on the basis of major forest regions. In general, however, the vegetation of wetlands resembles the upland vegetation of more northerly regions. Thus the hardwood swamps of the Eastern Temperate Wetland Region, dominated by maple (*Acer*), resemble the upland vegetation in the Low Boreal Wetland Region. The closed-canopy spruce (*Picea*) forests growing on bogs in the Low Boreal Wetland Region resemble the upland vegetation in the High Boreal Wetland Region. The open spruce-lichen woodlands characteristic of perennially frozen peatlands in the High Boreal Wetland Region appear in the uplands of the High Subarctic Wetland Region. This phenomenon may be explained by the observation that most wetlands occur in depressions that tend to be cooler than the nearby uplands. Furthermore, the soils are waterlogged, and much of the available heat is used to evaporate the water, rather than warming the soil (Williams 1968).

A brief characterization of the wetland regions of Canada follows.

HIGH ARCTIC Wetland Region (A_H on Figure 2)

The characteristic wetlands are basin fens and seepage fens. The climate is cold, with cold, short summers and very cold winters. The precipitation is very low (Table 1).

Peat development is minimal, the common maximum thickness is about 50 cm. In some areas cryoturbation is sufficiently intense to prevent the establishment of plants, resulting in nearly barren, frost-patterned ground, without any peat development.

Permafrost underlies all wetlands. The maximum development of the thawed active layer is less than 40 cm.

MID-ARCTIC Wetland Region (A_M on Figure 2)

The characteristic wetlands are flat fens and basin fens with small, elevated peat mounds. Low-center polygons occur locally, but high-center lowland polygons are rare. The climate is cold and arid (Table 1).

Permafrost underlies all wetlands. The active layer on the peat mounds under the better-drained peat is about 30 cm, and on the wet fens it is about 40 cm. The thickness of peat is less than 150 cm on the peat mounds, and usually less than 50 cm on the fens.

LOW ARCTIC Wetland Region (A_L on Figure 2)

The characteristic wetlands are lowland polygons, both the low-center and high-center varieties (Zoltai and Tarnocai 1975). The large expanses of tundra, covered with tussock-

Figure 2: Wetland Regions of Canada

A_H - High Arctic; A_M - Mid-Arctic; A_L - Low Arctic; S_H - High Subarctic; S_L - Low Subarctic; S_A - Atlantic Subarctic; B_H - High Boreal; B_M - Mid-Boreal; B_A - Atlantic Boreal; B_L - Low Boreal; P - Prairies; P_I - Intermountain Prairies; T_E - Eastern Temperate; T_P - Pacific Temperate; O_A - Atlantic Oceanic; O_P - Pacific Oceanic; M_X - Mountain Complex.

Wetland Districts are identified by lower-case subscript (see text). District boundaries are shown by heavily dotted lines.

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forming graminoid species such as *Eriophorum vaginatum* and *Carex bigelowii* are not considered to be wetlands, as they are not waterlogged throughout the year. This view is in agreement with the definition of tundra bogs in Siberia (Boch 1974). Other wetlands, such as floodplain and delta fens, and tidal marshes may occur in hydrologically suitable areas. The climate is characterized by cool summers and low precipitation (Table 1).

Permafrost underlies all wetlands. The active layer on the wet fens may reach 80 cm, but is usually only 40 cm on the better-drained high-center polygons. The common maximum thickness of peat on high-center polygons is about 2 m, but only about 50 cm on the polygonal fens.

HIGH SUBARCTIC Wetland Region (S_H on Figure 2)

The characteristic wetlands are polygonal peat plateaus with local basin fens and shore fens. In the area along Hudson Bay, which has

Table 1: Average Temperature and Precipitation Ranges in the Wetland Regions of Canada[1]

Wetland Region	Mean daily January temp. (°C)	Mean daily July temp. (°C)	Mean annual total precip. (cm)	Mean depth of snow, Feb. 28 (cm)
A_H	-30 - -40	3 - 6	8 - 20	15 - 45
A_M	-30 - -35	4 - 10	10 - 20	20 - 50
A_L	-28 - -32	10 - 13	20 - 25	40 - 50
S_H	-26 - -30	10 - 16	25 - 35	40 - 50
S_L	-23 - -30	14 - 17	30 - 50	50 - 60
S_A	- 7 - -12	13 - 16	100 - 105	20 - 50
B_H	-18 - -23	14 - 18	30 - 80	45 - 65
B_{Mh}	-18 - -23	13 - 18	65 - 100	50 - 100
B_{Mc}	-15 - -23	16 - 18	40 - 65	30 - 50
B_L	- 7 - -18	18 - 21	60 - 105	40 - 100
B_A	0 - -18	16 - 18	90 - 130	40 - 75
T_E	- 4 - - 7	20 - 22	80 - 100	0 - 30
T_P	2 - - 1	18 - 19	100 - 150	0
O_A	- 8 - -10	10 - 13	100 - 130	20 - 50
O_P	4 - - 1	13 - 16	230 - 255	0
P_a	-12 - -18	17 - 20	30 - 45	15 - 30
P_g	-12 - -18	18 - 20	30 - 40	10 - 20
P_I	- 4 - - 8	18 - 20	40 - 50	30

[1] Source: Anon. 1962. The climate of Canada. In: The Canada Year Book, 1959-1960, Dom. Bur. Statistics.

Anon. 1973. The National Atlas of Canada, Dep. Energy, Mines, Res., Surv. Mapping Br.

recently emerged from the Bay, polygon development is lacking. In the fens, small, incipient palsas are a common and conspicuous feature in this part of the region. Here, in the coastal zone, extensive fens are found dominated by *Carex*. In hydrologically suitable areas delta fens and floodplain fens develop. Tidal marshes occur along Hudson Bay, generally below the lowest relict beach. The climate is characterized by cool summers and low precipitation (Table 1).

Permafrost underlies all wetlands, except some shore fens located within a few metres of a lake. The active layer on the fens may be as much as 1 m thick, but only about 40 cm on the polygonal peat plateaus. The common maximum peat thickness is about 3 m.

LOW SUBARCTIC Wetland Region (S_L on Figure 2)

The common wetlands are peat plateaus, and patterned (ribbed, or strings) and flat fens. Palsas are frequent in the areas generally east of Nelson River in Manitoba, but are far more restricted farther west. The climate is charac-

terized by cold winters, but moderately cool summers. The precipitation is low in the west, but considerably higher east of Nelson River (Table 1).

Permafrost occurs only under peat plateaus and palsas, but not under fens. The active layer is about 60 cm at its maximum development. The common maximum thickness of peat is about 4 m.

ATLANTIC SUBARCTIC Wetland Region (S_A on Fig. 2)

Characteristic of this region are slope bogs, small basin bogs, and/or exposed elevations patterned for veneer. Extensive complexes of slope bog and slope fen occur on mountain slopes. The climate is characterized by cool winters and summers, and by high precipitation (Table 1). Frequent windstorms result in reduced snow cover in winter.

The common maximum thickness of peat in bogs is 2-3 m. In patterned fen veneers, the peat thickness varies from a few centimetres to 2 m. Permafrost is absent.

HIGH BOREAL Wetland Region (B_H on Figure 2)

The characteristic wetlands are ribbed and netted fens, small, wooded peat plateaus and palsas with collapse scars, and flat bogs and fens. In suitable areas shore fens, delta fens, and floodplain fens may develop. Tidal marshes occur near Hudson Bay. The climate is characterized by cold winters and moderately cool summers. Precipitation is low in the west, but increases in the eastern part of the region (Table 1).

Permafrost occurs only in the peat plateaus and palsas. While the permafrost is thin (commonly 2-3 m) in the southern fringe of the region, its thickness commonly exceeds 5 m elsewhere. The active layer is about 1 m thick. The common maximum thickness of the peat is about 5 m.

MID-BOREAL Wetland Region (B_M on Figure 2)

The characteristic wetlands are treed bogs and fens in broad flats and in confined basins. Raised bogs are common in the humid east, but not in the subhumid west. Floating fens and thicket swamps may border lakes and ponds. Sufficient regional differences are apparent to recognize several wetland districts. The climate varies from cold winters and warm summers in the west to mild winters and cool summers in the east. Precipitation is high in the east near the ocean, gradually decreasing to the west (Table 1). Permafrost is absent.

Humid Mid-Boreal Wetland District (B_{Mh} on Figure 2)

Domed, flat and basin bogs are common, but fens are relatively scarce, except along ponds where marshes may also occur. Thicket swamps and spruce swamps may be locally common. Common peat depth on the bogs and fens is about 6 m.

Continental Mid-Boreal Wetland District B_{Mc} on Figure 2)

Flat bogs and basin bogs and fens are common, often associated with fens. Occasionally, somewhat elevated, flat-topped bog plateaus occur in larger fens, often separated by patterned fens. Locally, marshes can be found along lakeshores. The common maximum peat thickness is about 5 m.

Transitional Mid-Boreal Wetland District B_{Mt} on Figure 2)

This district is transitional between the Prairie to the south and the Boreal region. Basin fens and bogs, thicket swamps and marshes occupy the depressions in about equal proportions. Flat fens and floating fens occur along drainages and lakeshores. Peat accumulation is in the order of 3 m on bogs, but less in fens, and minimal in swamps and marshes.

LOW BOREAL Wetland Region (B_L on Figure 2)

The characteristic wetlands are treed bowl bogs that are often surrounded by conifer swamps. Hardwood swamps have a limited occurrence, occupying depressions with good air drainage. The climate is characterized by cold winters and warm summers, with relatively high precipitation, especially in the eastern part of the region (Table 1).

The common maximum thickness of peat in bogs and fens is about 5-7 m. In swamps the peat is well humified and seldom exceeds 50 cm in thickness, except where the swamp occurs on the fringe of a bog or fen.

ATLANTIC BOREAL Wetland Region (B_A on Figure 2)

The characteristic wetlands are domed, raised bogs, most with an eccentric pool pattern and associated fens. Small slope fens occur throughout the region. Large tidal and freshwater marshes occur along the seashore in areas of low relief. The climate is characterized by relatively mild winters, cool summers, and high amounts of precipitation (Table 1).

The common maximum thickness of peat is 8 m, with some bogs exceeding 10 m, but it rarely exceeds 2 m in slope fens. Peat accumulation is usually less than 50 cm in the marshes.

EASTERN TEMPERATE Wetland Region (T_E on Fig. 2)

The characteristic wetlands are hardwood swamps and coniferous bogs in basins of flats. Shore marshes and fens near ponds and along drainageways may occur. The climate is characterized by mild winters and warm summers, with relatively high amounts of precipitation (Table 1).

Peat is no longer forming under hardwood swamp condition, as the well decomposed surface peat was deposited during an earlier stage, perhaps under different climatic conditions. The thickness of peat is therefore variable, depending on the degree of oxidation. A common maximum thickness is 2 m.

PACIFIC TEMPERATE Wetland Region (T_P on Fig. 2)

The characteristic wetlands are coniferous swamps, flat and domed bogs, and flat fens. Floodplains and deltaic areas may contain extensive marshes. Locally tidal marshes may be found, especially in deltaic areas. The climate is humid and mild, with high rainfall, mild winters and warm summers.

The thickness of peat in the swamps is generally less than 1 m. The common maximum thickness of peat in the bogs is about 5 m. In the fens the peat seldom exceeds 1.5 m in thickness.

ATLANTIC OCEANIC Wetland Region (O_A on Fig. 2)

The characteristic wetlands are blanket bogs and plateau raised bogs. Small slope fens and slope bogs are often associated with the plateau raised bogs. The climate is characterized by cold winters and cool summers, with high amounts of precipitation (Table 1).

The peat thickness is less than 3 m in blanket bogs, but generally thicker in the plateau bogs, often reaching 5 m in thickness.

PACIFIC OCEANIC Wetland Region (O_P on Fig. 2)

The characteristic wetlands are slope bogs and raised bogs, with local flat fens. The climate is characterized by very high amounts of precipitation, most of it falling as rain. The winters are mild, but the summers are cool (Table 1).

The thickness of peat is usually less than 1 m in the fens, consisting of somewhat decomposed sedge peat. The common maximum thickness of peat is 3 m on slope bogs, and 5 m on raised bogs.

PRAIRIE Wetland Region (P on Figure 2)

Characteristic wetlands are marshes, usually in association with semi-permanent ponds. The climate is semi-arid, with cold winters and hot summers (Table 1). Two wetland districts were recognized on the basis of wetland development.

Aspen Parkland Prairie Wetland District (P_a on Figure 2)

Semi-permanent ponds and freshwater marshes usually support an encircling shrubby or treed border. Small depressions are often occupied by meadows and shrub carrs. Saline marshes may border larger lakes. There is a limited development of well humified peat, usually less than 50 cm thick.

Grassland Prairie Wetland District (P_g on Figure 2)

Wet meadows and fresh to saline marshes occupy depressions containing semi-permanent shallow lakes. Peat development is absent.

INTERMOUNTAIN PRAIRIE Wetland Region (P_I on Figure 2)

Characteristic wetlands are saline and freshwater marshes, usually bordering ephemeral or semi-permanent ponds. Peat development is absent. The climate is semi-arid, with hot summers and mild winters (Table 1).

MOUNTAIN COMPLEX (M_X on Figure 2)

Wetlands in mountainous areas occur only in the valleys and lower slopes. The kind of wetland developing at each location will depend on the latitude and elevation of the location. Thus, in an area, bogs typical of the boreal region may occur in the lowest valleys, but at higher elevation the wetlands will resemble those found in subarctic or arctic areas. Because of such complex vertical zonation, the wetlands of mountainous areas are not described here.

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CANADIAN WETLAND REGISTRY

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ABSTRACT

This paper and the data collection forms present the current approach to describing a wetland ecosystem in such a manner that the data is collected uniformly. This enables data to be compared regardless of where, and by whom, it was collected. The information contained in the Canadian Wetland Registry includes general information about the vegetation, soils, and hydrology; and photographs and cross-sections of the wetland. This registry has been designed to handle information manually but the registry forms have been set up in such a manner that the information can easily be converted for use in a computerized system at a later data. The registry will be kept at the Land Resource Research Institute, K.W. Neatby Building, Ottawa, and will be open to people interested in Canadian wetlands and in wetland research.

RÉSUMÉ

La démarche actuelle pour la description d'un écosystème de terres humides, à l'aide de données recueillies de façon uniformisée est présentée dans cet article et par les formules de recueil des données. Elle assure la comparabilité des données quelle qu'en soit l'origine (lieu, personne). Cet enregistrement des Terres Humides du Canada contient des renseignements généraux sur la station (emplacement, climat, forêt et régions de terres humides); la classification des terres humides; des données sur la végétation, les sols et l'hydrologie; ainsi que des photographies et des représentations en coupe des terres humides. Le registre a été conçu en vue d'un traitement manuel des données, mais les formules ont été établies de telle sorte que les données pourront facilement être informatisées. L'enregistrement sera gardé à l'Institut de recherche sur les terres, Immeuble K.W. Neatby, à Ottawa, et sera accessible à tous les intéressées.

INTRODUCTION

People from many disciplines are collecting wetland data for their own specific needs but, although this data is valuable, its usefulness is limited for the purpose of comparison and correlation with data collected by others. In addition to this, the data is not accessible to a wide variety of users.

In the Canadian Wetland Registry, data are collected for all those variables which are important in describing a wetland ecosystem. This Registry was set up in such a manner that the data is collected uniformly and thus comparison of wetland types can be carried out regardless of where, and by whom, the data was collected. The data stored in the system can serve as an inventory of the Canadian wetland types and as a data bank on wetlands. This information can be disseminated among researchers who are working on wetland projects and among people who would like to become familiar with the wetland types in their region or who would just like to clear up the confusion introduced into the literature by the use of so many wetland terms.

The preliminary form of the Wetland Registry was sent out on October 17, 1978 to the National Wetland Working Group members and to other interested people. The Wetland Registry presented in this paper is a modified version, with modifications and changes being based on the comments and criticisms received.

DATA ENTRY

It is important that a highly representative wetland ecosystem, one which is relatively uniform in its biotic and environmental features, be entered in the Wetland Registry (Appendix A).

The data is entered on the Registry forms in the following ways:

1. Enter by written format or codes. For example, Rowe's codes can be used for the vegetation regions. The name and address of the person collecting this information, the special notes, etc., are entered using the written format.

2. Enter by circling the number in front of the specific name. For example, 014 is circled if flat bog is to be entered.

3. Enter by indicating the horizon in which a variable is found. This is accomplished by inserting horizontal slashes (-) for one or more of the appropriate top six horizons (horizons 1 to 6) and vertical slashes (|) for one or more of the appropriate lower six horizons (horizons 7 to 12). If sphagnum peat occurs in the first and seventh horizons, for example, this is indicated by a horizontal and a vertical slash (a plus sign) in the first and seventh square.

horizons	1	2	3	4	5	6
	+					
horizons	7	8	9	10	11	12

4. Enter the value. For example, the percent slope.

5. Enter the photos, cross-sections and maps by attaching them to the appropriate space.

6. Except for the first page which gives the basic information, one or more pages can be used for different parts of the wetland registry system. For example, if the wetland consists of two or more plant communities or soil types, each should be recorded on a separate sheet. It is very important, however, that each page should carry the same site number as recorded on the first page of the specific registry entry.

DATA HANDLING AND DISTRIBUTION

The wetland registry is set up to handle information manually. One of the criteria used during the process of setting up the forms was that they could be fairly easily converted into a computerized system at a later date if it is decided that these materials be stored and handled in an automated fashion.

The registry will be kept at the Land Resource Research Institute, K.W. Neatby Bldg., Ottawa. I will check that material entering the system meets the standards and, from time to time, will disseminate a list of wetland types entered in the system to people interested in the Canadian wetlands and in wetland research. If people are interested in receiving specific information or examples, I will send out xerox copies or make them available to those who would like to view the material here in Ottawa.

EXPLANATION OF THE CANADIAN WETLAND REGISTRY

The Wetland Registry package and an example of a completed Registry package can be seen in Appendices A and B, respectively.

1. Header Information

The header is the key in which the site is uniquely identified along with the name and address of the person submitting the information. It appears at the top of the first page of each registry package. Data is recorded as written or fixed codes in the space provided.

1.1 Site Number

The site number is provided by the person collecting the information.

1.2 Date of Data Collection

A six digit numerical code represents day (first and second digits), month (third and fourth digits) and year (fifth and sixth digits).

For example, | 2 | 4 | 0 | 5 | 7 | 9 | 24th of May, 1979.

1.3 Province or Territory

A two digit number taken from the following table identifies the province or territory in which the site is located.

British Columbia	01
Alberta	02
Saskatchewan	03
Manitoba	04
Ontario	05
Quebec	06
Newfoundland	07
New Brunswick	08
Nova Scotia	09
Prince Edward Island	10
Yukon Territory	11
Northwest Territories	12

1.4 Name, Address and Telephone Number

The name, address and telephone number of the person who collected the data.

1.5 Climate

Climatic data from the nearest climatic station are recorded. The mean annual air temperature is recorded in ^{o}C and the total annual precipitation is recorded in mm.

1.6 Forest Region

Rowe's (1972) forest region codes are entered. For example: code B.20 should be entered for the Boreal-Upper Churchill Section.

1.7 Wetland Region

Wetland region and district codes are entered. This material has been prepared by S.C. Zoltai and appears in these proceedings.

1.8 Location

The N.T.S. number of the topographical map and the evelation of the site in meters are given in the first part. In the second part the point location of the site is recorded both by latitude and longitude as well as by the Universal Transverse Mercator (U.T.M.) grid reference. The U.T.M. grid covers all of Canada at a 1:250 000 scale and most settled areas at a 1:50 000 scale. The degrees, minutes and seconds are also recorded in the proper spaces.

Example: Latitude North 62°30'15",
Longitude West 110°30'20"

Latitude N Longitude W

6	2	3	0	1	5	1	1	0	3	0	2	0

The Universal Traverse Mercator (U.T.M.) grid will be entered in the following way:

a. Zone number (two spaces)

b. Letter identifying an area north or south of the equator, in 8° bands (one space)

c. Two letters identifying the specific 100 000 m square (two spaces)

d. Easting reading to the nearest 100 or 10 m (four spaces)

e. Northing reading to the nearest 100 or 10 m (four spaces)

Example: U.T.M. grid reference 18TVK92159437

1 8 T V K 9 2 1 5 9 4 3 7

On 1:250 000 maps, estimation is impossible to the nearest 10 m; in this case, it should be to the nearest 100 m. For the above example, the U.T.M. grid reference is 18TVK92209440.

2. Wetland Description

2.1 Wetland Classification

The revised wetland classification included in the Registry has been derived from several works (Jeglum et al 1974; Tarnocai 1970; 1974; Zoltai et al 1975; Zoltai and Tarnocai 1975), the information concerning the veneer bog can be found in Mills et al (1978), and updating of the marsh and shallow water classes are mainly from G.D. Adams (personal communication 1979).

This system of classification is carried out on three levels. At the highest level, the class level, the wetlands are classified according to their genesis. At the wetland form level they are classified according to their surface morphology, surface pattern, morphology of the underlying mineral terrain, hydrology, and the type of water. At the lowest level, the wetland type level, the wetlands are classified according to the general physiognomy of the vegetation cover.

2.1.1 Definition of Wetland

Wetland is defined as land having the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophylic vegetation and various kinds of biological activity which are adapted to the wet environment.

Wetlands include peatland, which is formed by the accumulation of plant materials, has more than 40 cm of peat, and is associated with Organic soils (excluding Folisols). They also include areas that are influenced by excess water but which, for climatic, edaphic or biotic reasons, produce little or no peat. These wetlands are associated with Gleysolic or the peaty phase of Gleysolic soils.

Shallow open water, generally less than 2 m deep, is also included in wetlands. In certain types of wetlands vegetation is lacking and soils are poorly developed as a result of frequent and drastic fluctuations of surface-water levels or of wave action, water flow, turbidity or high concentration of salts or other toxic substances in the water or in the soil. Such wetlands can be recognized by the presence of surface water or saturated soil at some time during each

year. Wetland also includes areas which are modified by water control structures or which are tilled and planted but which, if allowed to revert, again become saturated for long periods and are associated with wet soils (Gleysols) and hydrophylic vegetation.

Regional Criteria

1. ARCTIC WETLANDS occur (1) in peatlands; (2) on wet mineral terrain; (3) on areas periodically inundated by tides; and (4) on shallow open water bodies. These wetlands are associated with Organic Cryosols or Gleysolic Cryosols having the water table at, near, or above the surface. The Gleysolic Cryosols in this region commonly have a peaty surface layer. Exception: Some of the strongly eroded, high center lowland (peat) polygons are not considered to be wetlands.

2. BOREAL and SUBARCTIC WETLANDS occur (1) in peatlands; (2) on wet mineral terrain; (3) on areas periodically inundated by tides; and (4) on shallow open water bodies. In these regions wetlands are associated with Organic soils (excluding Folisols), Organic Cryosols and Gleysol or Gleysolic Cryosols, the latter two having the water table at, near, or above the surface. These Gleysols and Gleysolic Cryosols commonly have a peaty surface layer. Exception: Some areas on slopes associated with peaty Gleysolic Cryosols are not considered to be wetlands.

3. COASTAL, high rainfall WETLANDS occur (1) in peatlands; (2) on wet mineral terrain having a continuous water table at, near, or above the surface all through the year; (3) on areas which are periodically inundated by tides; and (4) on shallow open water bodies. These wetlands are associated with Organic soils (excluding Folisols) and Gleysols, some of which may have a peaty surface layer. Exceptions: (1) Areas which are periodically saturated by high rainfall but are able to drain freely during periods of no rain. (2) Areas associated with LFH (forest humus) materials are not considered to be wetlands.

4. TEMPERATE WETLANDS occur (1) in peatlands; (2) on wet mineral terrain; and (3) on shallow open water bodies. These wetlands are associated with Organic soils (excluding Folisols) and Gleysols, some of which may have a peaty surface layer.

5. PRAIRIE WETLANDS occur (1) on wet mineral terrain; and (2) on shallow open water. In this region wetlands are associated with Gleysolic soils, some of which may have a peaty surface layer. Gleysols associated with wetlands but having no peaty surface layer must have either a low chroma or prominent mottles of high chroma within 10 cm of the mineral surface.

2.1.2 Wetland Classes and Forms

The wetland classes bog, fen, marsh, swamp, and shallow water along with the associated wetland forms are given below.

Bog

A bog is a peat-covered or peat-filled wetland, generally with a high water table. The water table is at or near the surface. The bog surface is often raised, or level with the surrounding wetlands, and is virtually unaffected by the nutrient-rich ground waters from the surrounding mineral soils. Hence, the ground water of the bog is generally acid and low in nutrients. The dominant peat materials are sphagnum and forest peat underlain, at times, by fen peat. The associated soils are Fibrisols, Mesisols and Organic Cryosols. The bogs may be treed or treeless and they are usually covered with Sphagnum and feathermosses, and Ericaceous shrubs.

Fen

A fen is a peat-covered or peat-filled wetland with a high water table which is usually at or above the surface. The waters are mainly nutrient-rich, minerotrophic waters from mineral soils. The dominant peat materials are shallow to deep, well to moderately decomposed fen peat. The associated soils are Mesisols, Humisols and Organic Cryosols. The vegetation consists dominantly of sedges, grasses, reeds and brown mosses with some shrub cover and, at times, a scanty tree layer.

Marsh

A marsh is a mineral or a peat-filled wetland which is periodically inundated by standing or slowly moving waters. Surface water levels may fluctuate seasonally, with declining levels exposing drawndown zones of matted vegetation or mud flats. The waters are nutrient-rich. The substratum usually consists dominantly of mineral material, although some marshes are associated with peat deposits. The associated soils are dominantly Gleysols with some Humisols and Mesisols. Marshes characteristically show a zonal or mosaic surface pattern of vegetation comprised of unconsolidated grass and sedge sods, frequently interspersed with channels or pools of open water. Marshes may be bordered by peripheral bands of trees and shrubs, but the predominant vegetation consists of a variety of emergent

non-woody plants such as rushes, reeds, reedgrasses, and sedges. Where open water areas occur, a variety of submerged and floating aquatic plants flourish.

Swamp

A swamp is a peat-filled area or a mineral wetland with standing or gently flowing waters occurring in pools and channels. The water table is usually at or near the surface. There is strong water movement from margin or other mineral sources, hence the waters are nutrient-rich. If peat is present it is mainly well decomposed forest peat underlain at times by fen peat. The associated soils are Mesisols, Humisols and Gleysols. The vegetation is characterized by a dense tree cover of coniferous or deciduous species, tall shrubs, herbs, and some mosses.

Shallow Water

Shallow water is semi-permanent to permanent standing or flowing water with relatively large and stable expanses of open water, which are locally known as ponds, pools, sloughs, shallow lakes, bays, lagoons, oxbows, impoundment reaches or channels. Shallow waters are distinguished from deep waters by the upper 2 m limit, although depths may occasionally exceed this during periods of abnormal flooding. During droughts, low water, or inter-tidal periods, drawdown flats may be temporarily exposed. Included in this class are all basins in which summer open water zones exceed 8 ha in size, regardless of the extent of bordering wetlands. These shallow water units are delineated from wetland complexes by the outer border of floating vegetation mats or by mid-summer surface water levels, usually expressed by peripheral deep marsh emergents or shrubs. All other wetland basins less than 8 ha in area, with summer open water zones occupying 75% or more of the basin diameter, are classed as shallow water. The margins may be unvegetated, or rooted emergent vegetation including trees is confined to a narrow margin occupying no more than 25% of the basin diameter. Vegetation, if present in the open water zone, consists only of submerged and floating aquatic plant forms.

Tables of Wetland Forms

In Tables 1 to 5 are the classification keys to the various wetland forms comprising the bog, fen, marsh, swamp and shallow water classes.

2.1.3 Wetland Types

The term used to describe the wetland type is based on the general physiognomy of the vegetation cover. It is not a species description or vegetation community, but a term such as coniferous, hardwood, rush, low shrub, to be used in connection with the wetland form.

1. *Coniferous*

This wetland type is dominated by coniferous species in the tree layer. The most common species are *Picea mariana* and *Larix laricina* which grow on organic soils and represent a characteristic type in the Boreal Forest Regions. *Thuja occidentalis* is the most common species found in the nutrient-rich southern wetlands in eastern Canada and *Pinus contorta, Thuja plicata,* and *Chamaecyparis nootkatensis* occur on the Pacific coast wetlands.

2. *Hardwood*

This wetland type is dominated by hardwood species in the tree layer. The most common species are *Acer* spp., *Fraxinus nigra, Ulnus americana, Betula* spp., and *Populus balsamifera.* Wetlands of this type generally occur on mineral soils or on highly decomposed organic soils.

3. *Tall Shrub*

This wetland type includes both all shrubs (>1.5) and medium shrubs (0.5-1.5 m). The species include true shrubs and stunted trees.

4. *Low Shrub*

This wetland type includes both low shrubs (0.1-0.5 m) and ground shrubs (<0.1 m).

5. *Mixed Forb*

This wetland type is dominated by forb species (non-grassy herbs).

6. *Grass*

This wetland type is dominated by grass species.

7. *Rush*

This wetland type is dominated by *Scirpus* spp., *Juncus* spp., and *Typha latifolia.*

Table 1: Classification key to bog wetland forms

1. Surface raised above the surrounding terrain	
2. Surface convex	
3. Core frozen; abruptly domed; usually in fens	
4. Over 1 m high, diameter up to 100 m	Palsa Bog
4. Less than 1 m high, diameter up to 3 m	Peat Mound Bog
3. Core not frozen	
5. Convex surface small (1-3 m dia.) occurring in fens	Mound Bog
5. Convex surface often extensive; not occurring in fens	Domed Bog
2. Surface flat to irregular	
6. Core perennially frozen	
7. Surface with network of polygonal fissures	
8. Surface even	Polygonal Peat Plateau Bog
8. Surface with high centres in a polygonal network	Lowland Polygon Bog
7. Surface without polygonal fissures	
9. Surface about 1 m above the surrounding fen	Peat Plateau Bog
6. Core not frozen	
10. Bogs generally tear-drop shaped	Northern Plateau Bog
10. Bogs not tear-drop shaped; abundance of surface water	Atlantic Plateau Bog
1. Surface not raised above surrounding terrain	
11. Surface relatively level	
12. With abrupt marginal peat walls	Collapse Bog
12. Without marginal peat walls	
13. Adjacent to water bodies	
14. Floating	Floating Bog
14. Not floating	Shore Bog
13. Not adjacent to water bodies	
15. Surface flat; topographically confined	
16. Basin deposit; depth greatest in center	Basin Bog
16. Flat deposit; depth generally uniform	Flat Bog
15. Surface flat to undulating, often appreciably sloping	
17. Surface pattern of ridges and pools distinct	String Bog
17. Surface pattern of pools usually absent; extensive	Blanket Bog
11. Surface not level	
18. Core not frozen	
19. Surface concave	Bowl Bog
19. Surface appreciably sloping	Slope Bog
18. Core perennially frozen	
20. Surface appreciably sloping	Veneer Bog

Table 2: Classification key to fen wetland forms

1. Surface not raised above surrounding terrain except in low hummocks and ridges	
2. Surface pattern of ridges and depressions	
3. Sub-parallel pattern of ridges and furrows	
4. Broad pattern; often very extensive	
5. Northern regions; lowland drainage; peat deep	Northern Ribbed Fen
5. Atlantic regions; mainly upland drainage; peat shallow	Atlantic Ribbed Fen
4. Narrow ladderlike pattern; along bog flanks	Ladder Fen
3. Reticulate pattern of ridges	Net Fen
2. Without pronounced surface pattern	
5. Featureless, adjacent to water bodies	
6. Floating	Floating Fen
6. Not floating; located in main channel or along banks of continuously flowing or semi-permanent streams	Stream Fen
6. Not floating; located along shores of semi-permanent or permanent lakes	Shore Fen
5. With surface water or filled depressions; not adjacent to water bodies	
7. Depressed thaw hollows	Collapse Fen
1. Surface raised or appreciably sloping	
8. Mounds with frozen core in patterned fens	Palsa Fen
8. Without frozen core	
9. Surface irregular due to upwelling water	Spring Fen
9. Surface regular but sloping	Slope Fen
1. Surface flat or depressional	
10. Core perennially frozen	
11. Surface with network of polygonal fissures	Lowland Polygon Fen
10. Core not frozen	
12. Surface level without pronounced surface pattern	Horizontal Fen
12. Occupying abandoned glacial meltwater spillways, intermittent drainage courses or open-ended, eroded channels	Channel Fen

Table 3: Classification key to marsh wetland forms

1. Influenced by marine tidal water	
2. In river estuaries or connecting bays where tidal flats, channels and pools are periodically inundated by water of varying salinity	
3. Located above mean high water levels; inundated only at highest tides and/or storm surges	Estuarine High Marsh
3. Located below mean high water levels; frequently inundated	Estuarine Low Marsh
2. On marine terraces, flats, embayments or lagoons behind barrier beaches, remote from estuaries, where there is periodic inundation by tidal brackish or salt water, including salt spray	
4. Located above mean high tide levels; inundated only at flood tides	Coastal High Marsh
4. Located below mean high water tide levels	Coastal Low Marsh
1. Occupying valleys, gullies, channels, streams, floodplains and deltas	
5. Adjacent to, or flooded by, flowing water	
6. Located on active fluvial floodplains adjacent to channels	Floodplain Marsh
6. Occupying shorelines, bars, streambeds or islands in continuously flowing water courses	Stream Marsh
6. Occupying abandoned glacial meltwater spillways, intermittent drainage courses, or open-ended, eroded channels	Channel Marsh
5. Occupying deltas with open drainage or water circulation due to unrestricted connections to active river channels and/or lakes	
7. Seasonally inundated	Active Delta Marsh
7. Inundated only during infrequent high river flows or wind tides	Inactive Delta Marsh
1. Occupying topographically defined catch basins, fed by local runoff or ground water	
8. Flat or concave basins in topographic low areas at the terminus of internal drainage systems, forming a close catchment for ground water discharge or surface inflow	Terminal Basin Marsh
8. Shallow, gently sloping depressions that occur as natural swales or that occupy intervening areas between ridges or undulations on low-relief landforms	Shallow Basin Marsh
8. Sharply defined catch basin, usually located in high or intermediate topographic positions on moderate to high-relief hummocky moraine, glacio-lacustrine or glacio-fluvial landforms	Kettle Marsh
1. Not in topographically defined catch basins	
9. Occupying groundwater discharge sites, usually on or at the base of slopes	Seepage Track Marsh
9. Occupying the shores of semi-permanent or permanent lakes	Shore Marsh

Table 4: Classification key to swamp wetland forms

1. Adjacent to water body	
2. Located along banks of continuously flowing or semi-permanent streams	Stream Swamp
2. Located along shores of semi-permanent or permanent lakes	Shore Swamp
1. Not adjacent to permanent water body	
3. In topographically defined basins	
4. On perimeter of peatlands	Peat Margin Swamp
4. Basin deposit; depth greatest in centre	Basin Swamp
3. Not in topographically defined basins	
5. Flat deposit; depth generally uniform	Flat Swamp
5. Poorly drained area; associated with floodplains	Floodplain Swamp
5. Discharge area; surface irregular	Spring Swamp

Table 5: Classification key to shallow water forms

1. Inland; fresh to saline water bodies less than 2 m deep	
2. Continuously flowing water confined to main water course	Stream Water
2. Intermittently flowing water to discontinuous surface flow, confined to glacio-fluvial eroded spillways	Channel Water
2. Intermittent flow or overbank flooding; impounded behind levees or ridges on alluvial deposits	
3. On river floodplains	Oxbow Water
3. On deltas	Delta Water
2. Surface water catchment in topographically defined basins	
4. Basins in topographic low areas at terminus of drainage	Terminal Basin Water
4. Shallow, gently sloping basins with relatively uniform depth	Shallow Basin Water
4. Relatively deep, bowl-shaped basins with moderately sloping sides	Kettle Water
2. Not in topographically defined catch basins	
5. Occupying the shallow shore zone of semi-permanent or permanent open water bodies	Shore Water
1. Coastal, estuarine or marine water bodies less than 2 m deep	
6. Brackish water bodies located above mean high tide zone	Nontidal Water
6. Estuarine channels or bays periodically inundated by fresh and brackish water	Estuarine Water
6. Coastal lagoons or bays primarily influenced by tidal action and marine salt water	Tidal Water

8. *Sedge*

This wetland type is dominated by sedge (*Carex* spp.,) vegetation.

9. *Moss*

This wetlands type is dominated by moss species. The most common species are Sphagnum, feather and brown *(Drepanocladus* spp.) mosses.

10. *Lichen*

This wetland type is dominated by lichen (mostly *Cladonia*) species. The lichen type of wetland is characteristic of the Subarctic and Arctic Regions.

11. *Floating*

This wetland type is dominated by aquatic plants with leaves floating on the surface of the water. The most common group of plants associated with this wetland type belongs to the water-lily family (*Nymphaeaceae*) and *Lemna* spp.

12. *Submerged*

This wetland type is dominated by plants with leaves found mainly below the surface of the water. The most common species are *Sagittaria latifolia, Alisma plantago-aquatica* and some water mosses.

13. *Non-vegetated*

This wetland type has sparse or very sparse vegetation cover. The vegetation cover is less than 5%.

2.1.4 Data Entry

If, for example, Coniferous Peat-Plateau Bog is to be entered into the registry, the following numbers should be circles: 100 under wetland class, 007 under wetland form, and 0.01 under wetland type. The classification code number of this wetland is 107.01 and this is the number which should be entered after the wetland classification in the Registry.

2.2. Morphology

The categories under this headings are as follows:

Level - a percentage slope between 0 and 0.5%.

Concave or depressional - the centre is lower than the margins.

Domed - the elevated, convex, central area is much higher (greater than 1 m) than the margin.

Plateau - generally flat with minor surface irregularities and elevated up to 1 m above the surrounding peatland.

Patterned - characteristic pattern in the form of ridges, hollows, etc. occurring on the surface.

Depth of peat - the total depth of the peat deposit measured from the surface of the peat to the mineral contact.

Height - the total height of the peatland above the surrounding peatland or above the surface of the water.

Percent slope - slope of the wetland.

Area of wetland - the area (ha) of the wetland unit entered into the Registry.

3. Vegetation

Since several plant communities can occur on a wetland type, each plant community should be recorded on a separate sheet. Every sheet, however, should carry the same site number as recorded on the first page of the specific registry entry.

3.1 Vegetation Type

The vegetation type is determined according to the dominant species or species groups, e.g. Sphagnum; black spruce - Cladonia.

3.2 Plot Size

The size of the plot in m^2 is entered here.

3.3 Percent Cover of Layers

The percent cover of each vegetation layer should be entered here. These layers are as follows:

Tree
Tall shrub (> 1.5 m)
Medium shrub (0.5-1.5 m)
Low shrub (0.1-0.5 m)
Ground shrub (< 0.1 m)
Herb
Moss and Lichen
Submergent and Floating

3.4 Description of Site

The information recorded here relates to the vegetation plot. Wind exposure classes (minimal, moderate and severe), homogeneity classes of the vegetation (continuous, discontinuous, patchy and rare), and the microrelief of the ground (plane, convex, concave, microridge, hummocky, undulating and others) are entered in the registry form.

3.5 Tree Data

Information on one of each representative (dominant or co-dominant) tree species is recorded here. Specifically, the height (m), the diameter (cm) at breast height (DBH), the age (years) and the crown class should be measured for each of these sample trees. The crown classes are as follows:

1. *Dominant*

Trees with crowns extending above the general level of the forest canopy. They are larger than the average tree in the stand, have well-developed crowns which may be somewhat crowded on the sides.

2. *Co-dominant*

Trees with crowns forming the general level of the forest canopy. The crown is usually smaller than that of a dominant tree and is usually more crowded on the sides.

3. *Intermediate*

Trees with crowns below, but still extending into the general level of the forest canopy. They usually have small crowns that are considerably crowded on the sides.

4. *Overtopped*

Trees with crowns entirely below the general level of the forest canopy.

3.6 Species Data

The cover class and the sociability class should be listed for every species according to the vegetation layer (tree, shrub, herb, moss and lichen, and submergent and floating). The cover class must be entered but the sociability class is optional and is used in those areas where the Braun-Blanquet approach is followed. The cover and the sociability classes are estimated using the following scales.

Cover Classes

1. 0-5%
2. 6-10%
3. 11-25%
4. 26-50%
5. 51-75%
6. 76-95%
7. 96-100%

Sociability Classes

1 - Singly
2 - Small groups or tufts
3 - Large groups or patches
4 - Extensive patches and carpets covering 50-75% of the sample area
5 - Large carpet covering over 75% of the sample area

4. Soils

Since more than one soil can occur on a wetland type, each soil should be recorded on a separate sheet. Every sheet, however, should carry the same site number as recorded on the first page of the specific registry entry.

4.1 Description of Soils

Several references relating to this part of the registry are available. Some of these are Dumanski (1978), Canada Soil Survey Committee (1978), McKeague (1978) and Zoltai and Tarnocai (1975).

4.1.1 Morphology

The uppermost layer or horizon is noted in row 01; all subsequent layers or horizons are entered in order proceeding downward through the profile. A maximum of 12 layers or horizons can be accommodated.

4.1.2 Lithological Discontinuity (Lit. Dis.)

Roman numerals are used to indicate lithological discontinuity (Canada Soil Survey Committee 1978 and Dumanski 1978).

4.1.3 Master Layers and Horizons

A code is used to identify the master layers and horizons. These include A, B, C, L, F, H, O, R, and W (Canada Soil Survey Committee 1978).

4.1.4 Suffixes

Standard suffixes for the layers and horizons are found in Canada Soil Survey Committee (1978).

4.1.5 Modifiers

Numerical suffix modifiers are used to identify vertical subdivisions (Canada Soil Survey Committee 1978).

4.1.6. Depth of Layers and Horizons

The top of the organic deposit in organic soils or of the mineral deposit in mineral soils is considered to be the zero depth.

4.1.7 Color

The color of mineral and organic materials is recorded using Munsell notations (Dumanski 1978).

4.1.8 Peat Materials

A brief description of the type of peat materials listed on the registry form is given in the paper by Zoltai and Tarnocai (1975). The data is to be entered on the registry form according to the instructions given in the "Data Entry" section of this paper.

4.1.9 Textural Classes

The textural classes are determined on the basis of the percentage of clay and sand and are found by using the textural triangle (Canada Soil Survey Committee 1978). The data is to be entered on the registry form according to the instructions given in the "Data Entry" section of this paper.

4.1.10 Classification

Information on soil classification can be obtained from Canada Soil Survey Committee (1978).

4.2 Soil Analysis

The format for this section was taken from CanSIS (Canada Soil Information System), with slight modifications. Information about the analyses can be obtained from McKeague (1978). The numbering of the layers and horizons must follow the numbering sequence recorded on the soil morphology sheet (see Section 4.1.1). A list of the types of analyses that can be performed is found to the right of the tables on the registry form. In this checklist the analytical variables used are to be circled.

5. Hydrology

5.1 Origin of Water

The main source of the water entering the wetland ecosystem should be circled.

5.2 Type of Associated Water Body

The type of water body associated with the wetland should be circled.

5.3 Depth to Water Table

The depth to the water table (cm) is measured from the surface of the mineral or organic soil to the water table.

5.4 Water Analysis

The results of the chemical analysis of the water samples are recorded in this section. Information concerning the analytical methods can be obtained from McKeague (1978).

5.5 Type of Water Used for Analysis

Information is recorded concerning the origin of the water sample used for analysis. The data is to be entered in this part of the registry according to the instructions given in the "Data Entry" section of this paper.

6. Photographic Information

This space is provided for both aerial and ground photographs. The site location, the direction of north and the scale should be marked clearly on the aerial photograph. The aerial photo number should also be included. For the ground photographs a short description should be given of the main features shown on the photograph. Additional sheets can be added if more space is required.

7. Maps and Cross-sections

This space is provided for both an insert map and cross-sections of the wetland. The map could be a portion of the N.T.S. topographic map. The site should be marked clearly on the map along with highway and provincial road numbers, near-by settlements, rivers, lakes and the direction of north. The N.T.S. number and the scale of the map should also be indicated.

Cross-sections of the wetland are very important data. These cross-sections should be properly surveyed and not merely schematic sketches. On the cross-section, both the above- and below-ground components should be indicated. For example, the different vegetation associations, the surface morphology of the peatland, pools of water or the level of the lake, and different peat and mineral layers should appear. The location of the cross-sections should be indicated on the map. Additional sheets can be added if

more space is required.

8. References

All known published material relating to the wetland site should be listed.

ACKNOWLEDGEMENTS

The Canadian Wetland Registry would not have been possible without the cooperation of the members of the National Wetlands Working Group; F.C. Pollett (chairman), E.D. Wells, H.E. Hirvonen, A.D. Smith, A.N. Boissonneau, J. Shay, G.D. Adams, S.C. Zoltai and E.T. Oswald. Special thanks to H. Luttmerding, T.M. Lord, R. Louie, J. van Barneveld, H.E. Slavinski and E.T. Oswald for discussions held during a field tour in British Columbia and for their comments relating to the definition of wetland. Special thanks are due to S.C. Zoltai and A.N. Boissonneau for their comments concerning this definition.

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APPENDIX A

The Canadian Wetland Registry requires a set of standardized forms for field description of wetland sites that is applicable throughout the nation. In the pages that follow, a set of registry forms are proposed for this purpose. Field testing and comments are welcomed. These forms are available in English or French either from the author or from the CCELC Secretariat, Lands Directorate, Environment Canada, Ottawa, K1AOE7.

The forms that follow include eight different sheets to comprise the registry package:

1. Canadian Wetland Registry - Site Data
2. Vegetation Descriptions
3. Soil Descriptions
4. Soil Chemical and Physical Analysis
5. Hydrology
6. Site Maps and Cross-Sections
7. Site Photographs and Information
8. Site References

Several forms in this registry package are intentionally repeated to allow adequate description of complex sites.

APPENDIX B

Examples of completed Wetland Registry forms for sites in Newfoundland and Northern Manitoba are presented with actual site information, photographs, cross-sections and analytical data.

APPENDIX A

CANADIAN WETLAND REGISTRY

CANADA COMMITTEE ON ECOLOGICAL LAND CLASSIFICATION—WETLANDS WORKING GROUP

Site No. Date Province or Terr.

Name

Complete Address

CLIMATE:
Name of Station

Mean Temp. °C
Jan. July

Precipitation (mm)

FOREST REGION

WETLAND REGION
Region District

LOCATION:
NTS No.

Elevation (m)

Latitude N

Longitude W

Universal Transverse Mercator (UTM) grid

Phone No.

Postal Code

Zone Alpha Let. 100 000 m Easting Northing

WETLAND CLASSIFICATION

Wetland Class

100 Bog
200 Fen
300 Swamp
400 Marsh
500 Shallow Water

MORPHOLOGY

Depth of Peat (cm)
Height (cm)
Slope (%)
Area of Wetland (ha)
Perimeter of Wetland (km)
Area of Open Water (ha)

Wetland Form

Bog
001 Palsa
002 Peat Mound
003 Mound
004 Domed
005 Polygonal Peat Plateau
006 Lowland Polygon
007 Peat Plateau
008 Northern Plateau
009 Atlantic Plateau
010 Collapse
011 Floating
012 Shore
013 Basin
014 Flat
015 String
016 Blanket
017 Bowl
018 Slope
019 Veneer

Fen
001 Northern Ribbed
002 Atlantic Ribbed
003 Ladder
004 Net
005 Floating
006 Stream
007 Shore
008 Collapse
009 Palsa
010 Spring
011 Slope
012 Lowland Polygon
013 Horizontal
014 Channel

Swamp
001 Stream
002 Shore
003 Peat Margin
004 Basin
005 Flat
006 Floodplain
007 Spring

Marsh
001 Estuarine High
002 Estuarine Low
003 Coastal High
004 Coastal Low
005 Floodplain
006 Stream
007 Channel
008 Active Delta
009 Inactive Delta
010 Terminal Basin
011 Shallow Basin
012 Kettle
013 Seepage Track
014 Shore

Shallow Water
001 Stream
002 Channel
003 Oxbow
004 Delta
005 Terminal Basin
006 Shallow Basin
007 Kettle
008 Shore
009 Nontidal
010 Estuarine
011 Tidal

Wetland Type

0.01 Coniferous
0.02 Hardwood
0.03 Tall Shrub
0.04 Low Shrub
0.05 Mixed Forb
0.06 Grass
0.07 Rush
0.08 Sedge
0.09 Moss
0.10 Lichen
0.11 Floating Aquatic
0.12 Submerged Aquatic
0.13 Non-vegetated

SPECIAL NOTES

Site No.

HYDROLOGY

ORIGIN OF WATER

01 Precipitation
02 Ground water
03 Stream water
04 Lake water
05 Brackish water
06 Salt water

TYPE OF ASSOCIATED WATER BODY

07 Shallow Pond
08 Shallow Lake
09 Lake
10 Water Track
11 Tidal Channel

DEPTH TO WATER TABLE

Max. (cm)

Min. (cm)

Date

NO.	DATE	DEPTH TO WATER TABLE (cm)

WATER ANALYSIS

NO.	LAB. NO.	pH	CONDUCTIVITY (mmhos/cm)	CATIONS (ppm)			TOTAL CATIONS (ppm)	ANIONS (ppm)			TOTAL ANIONS (ppm)
				Ca^{++}	Mg^{++}	Na^{+}		SO_4^{--}	Cl^{-}	HCO_3^{-}	
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											
11											
12											

TYPE OF WATER USED FOR ANALYSIS

	1	2	3	4	5	6
Ground water						
Stream water						
Lake water						
Tidal water						
Soil water						

SPECIAL NOTES

SOIL

Site No. | | | |

MORPHOLOGY

NO	LIT. DIS.	MASTER LAYER/ HORIZON	SUFFIXES	MODIFIER	DEPTH (cm) UPPER LIMIT	DEPTH (cm) LOWER LIMIT	COLOR ASPECT	COLOR HUE	COLOR SYM-BOL	COLOR VALUE	COLOR CHRO-MA
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											
11											
12											

COLOR ASPECT
m - moist
d - dry
f - frozen

PEAT AND LIMNIC MATERIALS

	1	2	3	4	5	6
Sphagnum Peat						
Brown Moss-Fen Peat						
Sedge-Fen Peat						
Woody-Fen Peat						
Woody-Forest Peat						
Feather Moss-Forest Peat						
Lichen-Forest Peat						
Aquatic Peat						
Mixed Peat						
Marl						
Coprogenous earth						
Diatomaceous earth						

TEXTURE

MINERAL	1	2	3	4	5	6
Sand						
Loamy Sand						
Sandy Loam						
Loam						
Silt Loam						
Silt						
Sandy Clay Loam						
Clay Loam						
Silty Clay Loam						
Sandy Clay						
Silty Clay						
Clay						
Heavy Clay						

ORGANIC						
Fibric						
Mesic						
Humic						

CLASSIFICATION

ORGANIC
01 Typic Fibrisol
02 Mesic Fibrisol
03 Humic Fibrisol
04 Limno Fibrisol
05 Cumulo Fibrisol
06 Terric Fibrisol
07 Terric Mesic Fibrisol
08 Terric Humic Fibrisol
09 Hydric Fibrisol
10 Typic Mesisol
11 Fibric Mesisol
12 Humic Mesisol
13 Limno Mesisol
14 Cumulo Mesisol
15 Terric Mesisol
16 Terric Fibric Mesisol
17 Terric Humic Mesisol
18 Hydric Mesisol
19 Typic Humisol
20 Fibric Humisol
21 Mesic Humisol
22 Limno Humisol
23 Cumulo Humisol
24 Terric Humisol
25 Terric Fibric Humisol
26 Terric Mesic Humisol
27 Hydric Humisol

GLEYSOLIC
28 Orthic Humic Gleysol
29 Rego Humic Gleysol
30 Fera Humic Gleysol
31 Orthic Gleysol
32 Rego Gleysol
33 Fera Gleysol
34 Orthic Luvic Gleysol
35 Humic Luvic Gleysol
36 Fera Luvic Gleysol
37 Fragic Luvic Gleysol

CRYOSOLIC
38 Fibric Organic Cryosol
39 Mesic Organic Cryosol
40 Humic Organic Cryosol
41 Terric Fibric Organic Cryosol
42 Terric Mesic Organic Cryosol
43 Terric Humic Organic Cryosol
44 Glacic Organic Cryosol
45 Gleysolic Turbic Cryosol
46 Gleysolic Static Cryosol

SPECIAL NOTES

Site No. [ ]

SOIL ANALYSIS

Chemical Analysis

NO.	LABORATORY SAMPLE NO.	PH 1 VALUE	PH 2 VALUE	ORGANIC CARBON (%)	PYROPHOSPH. SOL (%)	TOTAL NITROGEN (%)	ELECTRICAL CONDUCTIVITY (mmhos/cm)	C.E.C. (me/100g)	EXCHANGEABLE CATIONS (me/100g) Ca	Mg	Na	K
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												

Physical Analysis

NO	PARTICLE SIZE ANALYSIS (%) OF SAMPLE V C SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOTAL SAND	70-2 u SILT	50-2 u SILT	< 2 u CLAY	< 0.2 u CLAY	BULK DENSITY (g/cc)	MOISTURE (%)	ICE (%)	RUBBED FIBRE (%)	UNRUBBED FIBRE (%)	ASH (%)
01																
02																
03																
04																
05																
06																
07																
08																
09																
10																
11																
12																

SPECIAL NOTES

pH

pH value 1
Sample state
T 021 Field state
T 022 Air dry

Method
T 031 Water 1:1
T 032 Water 1:5
T 033 Water saturated
T 034 Calcium chloride
T 035 Potassium chloride
T 036 Sodium fluoride

pH value 2
Sample state
T 041 Field State
T 042 Air dry

Method
T 051 Water 1:1
T 052 Water 1:5
T 053 Water saturated
T 054 Calcium chloride
T 055 Potassium chloride
T 056 Sodium fluoride

EXCHANGEABLE CATIONS

Neutral salt
Extractant
T 141 $CaCl_2$
T 142 KCl
T 143 NaCl
T 144 $BaCl_2$
T 145 K_2SO_4

Analytical Procedure
T 151 EDTA titration
T 152 Phosphate titration
T 153 EtOH titration
T 154 Aluminon titration
T 155 Flame photometry
T 156 Atomic absorption
T 157 Auto-analyzer

CATION EXCHANGE CAPACITY

Permanent charge
T 121 Neutral salt, long method
T 122 Neutral salt, rapid method

ORGANIC CARBON

T 061 Dry combustion, induction furnace
T 062 Wet oxidation (Allison)
T 063 Wet oxidation (Walkley-Black)
T 064 Dry combustion, resistance furnace
T 065 Pyrophosphate soluble

TOTAL NITROGEN

T 071 Semi-micro, NO_2 & NO_3 included
T 072 Semi-micro, NO_2 & NO_3 not included
T 073 Macro-Kjeldahl, NO_2 & NO_3 included
T 074 Macro-Kjeldahl, NO_2 & NO_3 not included
T 075 Micro-Kjeldahl
T 076 Nitrogen analyser

RUBBED FIBRE

T 501 Visual estimate
T 502 Syringe
T 503 Gravimetric

UNRUBBED FIBRE

T 511 Visual estimate
T 512 Syringe
T 513 Gravimetric

PERCENT ASH

T 521 Dry ashing
T 522 Wet ashing

PARTICLE SIZE ANALYSIS

Pretreatment
Removal of:
T 531 Carbonates
T 532 Organic matter
T 533 Iron oxides
T 534 Soluble salts

Dispersion
T 541 Sodium hexametaphosphate
T 542 Sodium hydroxide
T 543 Sonic

Method
T 551 Pipette
T 552 Hydrometer
T 553 Plummet
T 554 Decanting
T 555 Ultra sonic sieving
T 556 X-ray
T 557 Wet sieving

BULK DENSITY

Sample state
T 561 Field state
T 562 Air dry
T 563 Oven dry
T 564 30 cm absorption
T 565 1/3 bar desorption

Organic soils
T 581 Core samples
T 582 McCauley peat auger samples
T 583 Steel-pin sampling board

PYROPHOSPHATE SOLUBILITY

T 940 Visually read
T 941 Spectrophotometer

VEGETATION

Site No.

Vegetation Type

Plot Size (m²)

Tree Cover (%)

Tall Shrub (> 1.5 m) Cover (%)

Medium Shrub (0.5 – 1.5 m) Cover(%)

Low Shrub (0.1 – 0.5 m) Cover (%)

Ground Shrub (< 0.1 m) Cover (%)

Herb Cover (%)

Moss and Lichen Cover (%)

Submergent and Floating Cover (%)

Exposure: 1. Minimal 2. Moderate 3. Severe
Homogeneity: 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief: 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

Tree Data

SPECIES NAME	HEIGHT (m)	D.B.H. (cm)	AGE (years)	CROWN CLASS

SPECIES NAME	TREES COVER. SOC.	SHRUBS COVER. SOC.	HERBS COVER. SOC.	MOSS AND LICHENS COVER SOC.	SUBMERGENT AND FLOATING COVER SOC

SPECIAL NOTES

MAPS AND CROSS-SECTIONS

Site No. ____

PHOTO INFORMATION

Site No. ____

REFERENCES

Site No. ____

APPENDIX B
EXAMPLE A

CANADIAN WETLAND REGISTRY

CANADA COMMITTEE ON ECOLOGICAL LAND CLASSIFICATION—WETLANDS WORKING GROUP

Site No 0023 Date 250680 Province or Terr 07

Name E DOYLE WELLS

Complete Address NFLD FOR RES CEN / CAN FOR SERVICE / ENV CANADA / P.O. BOX 6028, ST JOHN'S Postal Code A1C 5X8

Phone No 709-737-4813

CLIMATE Name of Station ST SHOTTS Mean Temp C Jan -3.1 July +12.1 Precipitation (mm) 1189

FOREST REGION B30

WETLAND REGION Region OA District

LOCATION NTS No 1K/12E Elevation (m) 152

Latitude N 463013 Longitude W 533000

Universal Transverse Mercator (UTM) grid: Zone 22 Alpha Let T 100 000 m CG Easting 0930 Northing 7630

WETLAND CLASSIFICATION 116.09

MORPHOLOGY

Depth of Peat (cm) 200
Height (cm)
Slope (%) 5
Area of Wetland (ha)
Perimeter of Wetland (km)
Area of Open Water (ha)

Wetland Class
100 Bog
200 Fen
300 Swamp
400 Marsh
500 Shallow Water

Wetland Form

Bog
001 Palsa
002 Peat Mound
003 Mound
004 Domed
005 Polygonal Peat Plateau
006 Lowland Polygon
007 Peat Plateau
008 Northern Plateau
009 Atlantic Plateau
010 Collapse
011 Floating
012 Shore
013 Basin
014 Flat
015 String
016 Blanket
017 Bowl
018 Slope
019 Veneer

Fen
001 Northern Ribbed
002 Atlantic Ribbed
003 Ladder
004 Net
005 Floating
006 Stream
007 Shore
008 Collapse
009 Palsa
010 Spring
011 Slope
012 Lowland Polygon
013 Horizontal
014 Channel

Swamp
001 Stream
002 Shore
003 Peat Margin
004 Basin
005 Flat
006 Floodplain
007 Spring

Marsh
001 Estuarine High
002 Estuarine Low
003 Coastal High
004 Coastal Low
005 Floodplain
006 Stream
007 Channel
008 Active Delta
009 Inactive Delta
010 Terminal Basin
011 Shallow Basin
012 Kettle
013 Seepage Track
014 Shore

Shallow Water
001 Stream
002 Channel
003 Oxbow
004 Delta
005 Terminal Basin
006 Shallow Basin
007 Kettle
008 Shore
009 Nontidal
010 Estuarine
011 Tidal

Wetland Type
0 01 Coniferous
0 02 Hardwood
0 03 Tall Shrub
0 04 Low Shrub
0 05 Mixed Forb
0 06 Grass
0 07 Rush
0 08 Sedge
0 09 Moss
0 10 Lichen
0 11 Floating Aquatic
0 12 Submerged Aquatic
0 13 Non-vegetated

SPECIAL NOTES

Site No. 0023

HYDROLOGY

ORIGIN OF WATER
01 Precipitation
02 Ground water
03 Stream water
04 Lake water
05 Brackish water
06 Salt water

TYPE OF ASSOCIATED WATER BODY
07 Shallow Pond
08 Shallow Lake
09 Lake
10 Water Track
11 Tidal Channel

DEPTH TO WATER TABLE

Max (cm) 100 Min (cm)

Date

NO	DATE	DEPTH TO WATER TABLE (cm)

WATER ANALYSIS

NO	LAB NO	pH	CONDUCTIVITY (mmhos cm)	CATIONS (ppm) Ca	Mg	Na	TOTAL CATIONS (ppm)	ANIONS (ppm) SO_4	Cl	HCO_3	TOTAL ANIONS (ppm)
01	0h	3.6									
02											
03											
04											
05											
06											
07											
08											
09											
10											
11											
12											

TYPE OF WATER USED FOR ANALYSIS

	1	2	3	4	5	6
Ground water	✓					
Stream water						
Lake water						
Tidal water						
Soil water						

SPECIAL NOTES

SOIL

Site No. 0023

MORPHOLOGY

NO	LT DIS	MASTER LAYER/HORIZON	SUFFIXES	MODIFIER	DEPTH (cm) UPPER LIMIT	LOWER LIMIT	ASPECT	COLOR HUE	SYMBOL	VALUE	CHROMA
01		O	f		0	30	m				
02		O	m		30	70	m				
03		O	h		70	200	m				
04											
05											
06											
07											
08											
09											
10											
11											
12											

COLOR ASPECT
m - moist
d - dry
f - frozen

CLASSIFICATION

ORGANIC
01 Typic Fibrisol
02 Mesic Fibrisol
03 Humic Fibrisol
04 Limno Fibrisol
05 Cumulo Fibrisol
06 Terric Fibrisol
07 Terric Mesic Fibrisol
08 Terric Humic Fibrisol
09 Hydric Fibrisol
10 Typic Mesisol
11 Fibric Mesisol
12 Humic Mesisol
13 Limno Mesisol
14 Cumulo Mesisol
15 Terric Mesisol
16 Terric Fibric Mesisol
17 Terric Humic Mesisol
18 Hydric Mesisol
19 Typic Humisol
20 Fibric Humisol
21 Mesic Humisol
22 Limno Humisol
23 Cumulo Humisol
24 Terric Humisol
25 Terric Fibric Humisol
26 Terric Mesic Humisol
27 Hydric Humisol

GLEYSOLIC
28 Orthic Humic Gleysol
29 Rego Humic Gleysol
30 Fera Humic Gleysol
31 Orthic Gleysol
32 Rego Gleysol
33 Fera Gleysol
34 Orthic Luvic Gleysol
35 Humic Luvic Gleysol
36 Fera Luvic Gleysol
37 Fragic Luvic Gleysol

CRYOSOLIC
38 Fibric Organic Cryosol
39 Mesic Organic Cryosol
40 Humic Organic Cryosol
41 Terric Fibric Organic Cryosol
42 Terric Mesic Organic Cryosol
43 Terric Humic Organic Cryosol
44 Glacic Organic Cryosol
45 Gleysolic Turbic Cryosol
46 Gleysolic Static Cryosol

PEAT AND LIMNIC MATERIALS

	1	2	3	4	5	6
Sphagnum Peat	–	–				
Brown Moss-Fen Peat						
Sedge-Fen Peat			–			
Woody-Fen Peat						
Woody-Forest Peat						
Feather Moss-Forest Peat						
Lichen-Forest Peat						
Aquatic Peat						
Mixed Peat						
Marl						
Coprogenous earth						
Diatomaceous earth						

TEXTURE

MINERAL	1	2	3	4	5	6
Sand						
Loamy Sand						
Sandy Loam						
Loam						
Silt Loam						
Silt						
Sandy Clay Loam						
Clay Loam						
Silty Clay Loam						
Sandy Clay						
Silty Clay						
Clay						
Heavy Clay						
ORGANIC						
Fibric	–					
Mesic		–				
Humic			–			

SPECIAL NOTES

Site No 0023

SOIL ANALYSIS

Chemical Analysis

NO	LABORATORY SAMPLE NO	PH 1 VALUE	PH 2 VALUE	ORGANIC CARBON (%)	PYROPHOSPH SOL (%)	TOTAL NITROGEN (%)	ELECTRICAL CONDUCTIVITY (mmhos/cm)	C.E.C (me 100g)	EXCHANGEABLE CATIONS (me 100g) Ca	Mg	Na	K
01	0f	3.6				1 1.3						
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												

Physical Analysis

NO	PARTICLE SIZE ANALYSIS (%) OF SAMPLE VC SAND	C SAND	MED SAND	F SAND	VF SAND	TOTAL SAND	70-2u SILT	50 2u SILT	2u CLAY	0 2u CLAY	BULK DENSITY (g cc)	MOISTURE ( )	ICE (%)	RUBBED FIBRE (%)	UNRUBBED FIBRE (%)	ASH (%)
01																
02																
03																
04																
05																
06																
07																
08																
09																
10																
11																
12																

SPECIAL NOTES

pH

pH value 1
Sample state
T 021 Field state
T 022 Air dry

Method
T 031 Water 1 1
T 032 Water 1 5
T 033 Water saturated
T 034 Calcium chloride
T 035 Potassium chloride
T 036 Sodium fluoride

pH value 2
Sample state
T 041 Field State
T 042 Air dry

Method
T 051 Water 1 1
T 052 Water 1 5
T 053 Water saturated
T 054 Calcium chloride
T 055 Potassium chloride
T 056 Sodium fluoride

EXCHANGEABLE CATIONS

Neutral salt
Extractant
T 141 $CaCl_2$
T 142 KCl
T 143 NaCl
T 144 $BaCl_2$
T 145 K_2SO_4

Analytical Procedure
T 151 EDTA titration
T 152 Phosphate titration
T 153 EtOH titration
T 154 Aluminon titration
T 155 Flame photometry
T 156 Atomic absorption
T 157 Auto analyzer

CATION EXCHANGE CAPACITY

Permanent charge
T 121 Neutral salt long method
T 122 Neutral salt rapid method

ORGANIC CARBON

T 061 Dry combustion induction furnace
T 062 Wet oxidation (Allison)
T 063 Wet oxidation (Walkley Black)
T 064 Dry combustion resistance furnace
T 065 Pyrophosphate soluble

TOTAL NITROGEN

T 071 Semi micro NO_2 & NO_3 included
T 072 Semi micro NO_2 & NO_3 not included
T 073 Macro Kjeldahl NO_2 & NO_3 included
T 074 Macro Kjeldahl NO_2 & NO_3 not included
T 075 Micro Kjeldahl
T 076 Nitrogen analyser

RUBBED FIBRE

T 501 Visual estimate
T 502 Syringe
T 503 Gravimetric

UNRUBBED FIBRE

T 511 Visual estimate
T 512 Syringe
T 513 Gravimetric

PERCENT ASH

T 521 Dry ashing
T 522 Wet ashing

PARTICLE SIZE ANALYSIS

Pretreatment,
Removal of
T 531 Carbonates
T 532 Organic matter
T 533 Iron oxides
T 534 Soluble salts

Dispersion
T 541 Sodium hexametaphosphate
T 542 Sodium hydroxide
T 543 Sonic

Method
T 551 Pipette
T 552 Hydrometer
T 553 Plummet
T 554 Decanting
T 555 Ultra sonic sieving
T 556 X ray
T 557 Wet sieving

BULK DENSITY

Sample state
T 561 Field state
T 562 Air dry
T 563 Oven dry
T 564 30 cm absorption
T 565 1 3 bar desorption

Organic soils
T 581 Core samples
T 582 McCauley peat auger samples
T 583 Steel pin sampling board

PYROPHOSPHATE SOLUBILITY

T 940 Visually read
T 941 Spectrophotometer

VEGETATION

Site No 0023

Vegetation Type: KALMIO-SPHAGNETUM FUSCI

Plot Size (m²)	3
Tree Cover (%)	0
Tall Shrub (> 1.5 m) Cover (%)	0
Medium Shrub (0.5 – 1.5 m) Cover (%)	0
Low Shrub (0.1 – 0.5 m) Cover (%)	35
Ground Shrub (< 0.1 m) Cover (%)	5
Herb Cover (%)	15
Moss and Lichen Cover (%)	90
Submergent and Floating Cover (%)	0

Exposure 1. Minimal 2. Moderate 3. Severe
Homogeneity 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

Tree Data

SPECIES NAME	HEIGHT (m)	D B H (cm)	AGE (years)	CROWN CLASS

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
Kalmia angustifolia		2.1			
Ledum groenlandicum		1.1			
Chamaedaphne calyculata		1.1			
Kalmia polifolia		2.1			
Vaccinium oxycoccus		2.1			
Pyrus floribunda		+			
Myrica gale		1.1			
Cornus canadensis			+		
Coptis groenlandica			1.1		
Smilacina trifolia			r		
Solidago uliginosa			+		
Calamagrostis inexpansa			1.1		
Scirpus cespitosus			1.2		
Sphagnum fuscum				3.3	
Sphagnum rubellum				2.2	
Polytrichum strictum				2.1	
Mylia anomala				2.1	
Cetraria islandica				+	
Cladonia rangiferina				1.2	
Cladonia arbuscula				2.2	
Cladonia alpestris				2.2	
Cladonia pyxidata				+	
Cladonia alpicola				+	

SPECIAL NOTES

DOMINANT VEGETATION TYPE; SPHAGNUM FUSCUM FORMS EXTENSIVE CARPETS (HUMMOCKS AND FLATS); TUSSOCKS OF SCIRPUS CESPITOSUS ABUNDANT

VEGETATION

Site No 0023

Vegetation Type: VACCINIO-CLADONIETUM BORYI

Plot Size (m²)	1
Tree Cover (%)	0
Tall Shrub (> 1.5 m) Cover (%)	0
Medium Shrub (0.5 – 1.5 m) Cover (%)	0
Low Shrub (0.1 – 0.5 m) Cover (%)	10
Ground Shrub (< 0.1 m) Cover (%)	15
Herb Cover (%)	0
Moss and Lichen Cover (%)	80
Submergent and Floating Cover (%)	0

Exposure 1. Minimal 2. Moderate 3. Severe
Homogeneity 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

Tree Data

SPECIES NAME	HEIGHT (m)	D B H (cm)	AGE (years)	CROWN CLASS

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
Kalmia angustifolia		2.1			
Ledum groenlandicum		1.1			
Rubus chamaemorus		+			
Empetrum nigrum		2.3			
Vaccinium vitis-idaea		1.1			
Vaccinium angustifolium		2.1			
Cornicularia aculeata				1.2	
Cladonia boryi				+	
Cladonia uncialis				1.2	
Cladonia rangiferina				2.1	
Cladonia arbuscula				1.1	
Cladonia alpestris				1.2	
Hypogymnia physodes				+	
Cetraria islandica				1.1	
Ochrolechia frigida				1.2	

SPECIAL NOTES

LICHENS VERY ABUNDANT, USUALLY REPLACING (OVER-GROWING) THE SPHAGNUM FUSCUM HUMMOCKS; SITE IS VERY DRY; MOST COMMON IN EXPOSED COASTAL SITES.

Vegetation Type: SCIRPO-SPHAGNETUM TENELLI

Plot Size (m²)	1
Tree Cover (%)	0
Tall Shrub (> 1.5 m) Cover (%)	0
Medium Shrub (0.5 – 1.5 m) Cover (%)	0
Low Shrub (0.1 – 0.5 m) Cover (%)	10
Ground Shrub (< 0.1 m) Cover (%)	5
Herb Cover (%)	25
Moss and Lichen Cover (%)	85
Submergent and Floating Cover (%)	

Exposure: 1. Minimal 2. Moderate 3. Severe
Homogeneity: 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief: 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
Andromeda glaucophylla		2.1			
Kalmia polifolia		1.1			
Chamaedaphne calyculata		+			
Gaylussacia dumosa		1.1			
Vaccinium oxycoccus		1.1			
Drosera rotundifolia			1.1		
Trientalis borealis			1.1		
Solidago uliginosa			+		
Sarracenia purpurea			+		
Scirpus caespitosus			2.2		
Carex exilis			1.2		
Carex oligosperma			1.1		
Carex rostrata			+		
Sphagnum rubellum				1.1	
Sphagnum tenellum				3.2	
Sphagnum flavicomans				1.2	
Odontoschisma sphagni				1.1	
Cladopodiella fluitans				1.2	
Cephalozia connivens				1.1	
Cetraria islandica				1.1	
Cladonia arbuscula				2.2	
Cladonia rangiferina				1.1	
Cladonia mitis				1.1	
Cladonia uncialis				+	
Sphagnum torreyanum Community					
Andromeda glaucophylla		1.1			
Chamaedaphne calyculata		+			
Carex exilis			+		
Carex oligosperma			2.1		
Sphagnum torreyanum				5.5 (→)	
Sphagnum pulchrum				1.2 (→)	
Sphagnum papillosum				2.1 (→)	

Tree Data

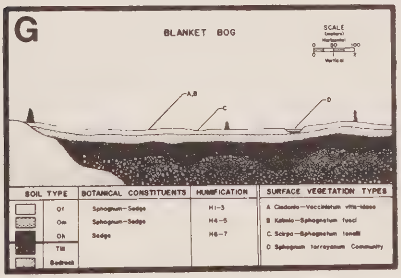
SPECIES NAME	HEIGHT (m)	D.B.H. (cm)	AGE (years)	CROWN CLASS

SPECIAL NOTES

HOLLOWS ON OMBROTROPHIC SITES; WATER TABLE AT SURFACE; SITE USUALLY NOT INUNDATED EXCEPT IN SPRING; SPHAGNUM TORREYANUM COMMUNITY CONSISTS OF SHALLOW POOL; VEGETATION IS SUBMERGED OR FLOATING; SOMETIMES POOL BORDERS

MAPS AND CROSS-SECTIONS

Site No. 0023



G. Profile of blanket bog (F)

H. Location of blanket bog. NTS 1K (1:250,000)

I. Map of Newfoundland showing area (H)

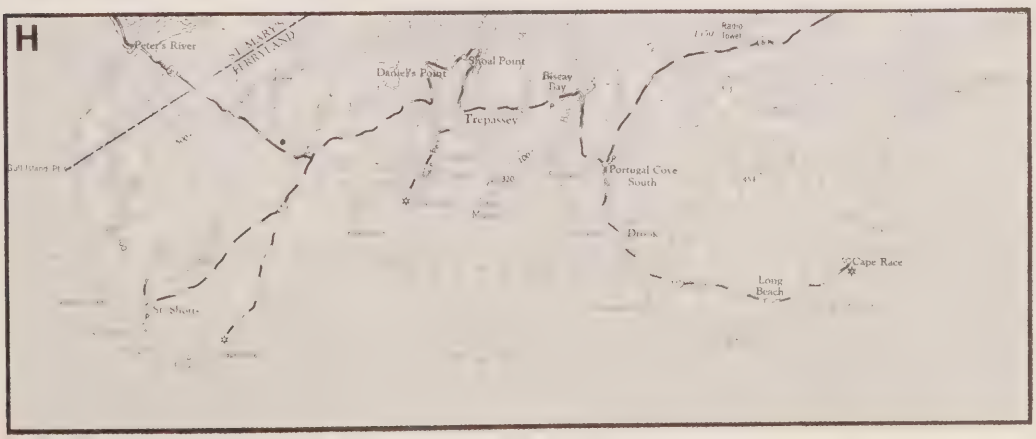
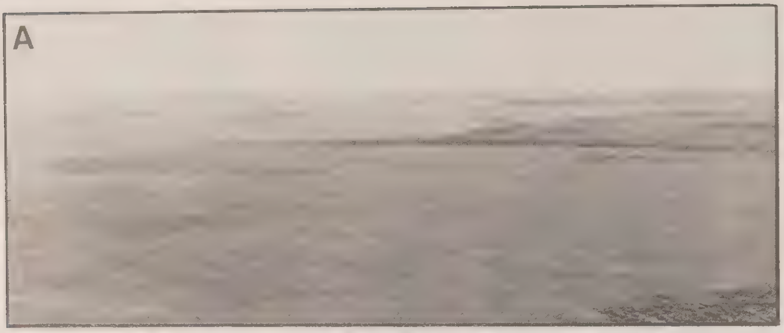
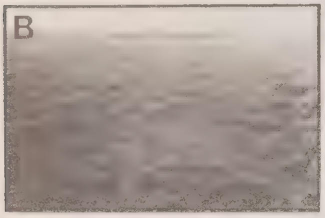
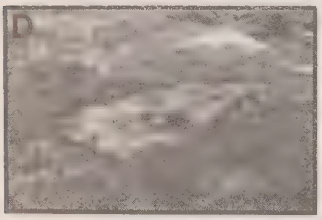


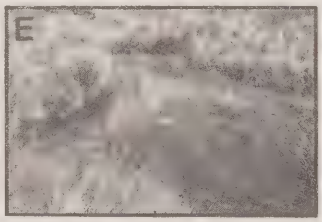
PHOTO INFORMATION

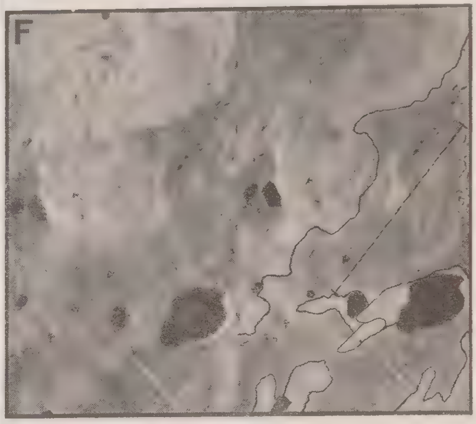
Site No 0023











A. Oblique aerial photograph of blanket bog.

B. Dominant vegetation (Kalmio-Sphagnetum fusci)

C. Lichen-covered hummock (Vaccinio-Cladonietum boryi)

D. Wet hollow (Scirpo-Sphagnetum tenelli)

E. Shallow pool (Sphagnum torreyanum Community)

F. Stereogram of blanket bog. Scale 1:15,840.

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Site No. 0023

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EXAMPLE B

CANADIAN WETLAND REGISTRY

CANADA COMMITTEE ON ECOLOGICAL LAND CLASSIFICATION—WETLANDS WORKING GROUP

Site No: M001 | Date: 211079 | Province or Terr: 04

Name: CHARLES TARNOCAI

Complete Address: LAND RESOURCE / RESEARCH INST. / K. W. NEATBY BLDG. / OTTAWA, ONT. | Postal Code: K1A-0C6

Phone No: 995-2323

CLIMATE — Name of Station: CRANBERRY POR. | Mean Temp °C: Jan -1.2, July | Precipitation (mm): 441

FOREST REGION: B220

WETLAND REGION — Region: BMc | District:

LOCATION — NTS No: 63K | Elevation (m): 290 | Latitude N: 5431 | Longitude W: 10122

Universal Transverse Mercator (UTM) grid — Zone: 14 | Alpha Let: U | 100 000 m: LR | Easting: 4650 | Northing: 4250

WETLAND CLASSIFICATION: 101.01

Wetland Class

(100) Bog
200 Fen
300 Swamp
400 Marsh
500 Shallow Water

MORPHOLOGY

Depth of Peat (cm)	250
Height (cm)	224
Slope (%)	
Area of Wetland (ha)	
Perimeter of Wetland (km)	
Area of Open Water (ha)	

Wetland Form

Bog
(001) Palsa
002 Peat Mound
003 Mound
004 Domed
005 Polygonal Peat Plateau
006 Lowland Polygon
007 Peat Plateau
008 Northern Plateau
009 Atlantic Plateau
010 Collapse
011 Floating
012 Shore
013 Basin
014 Flat
015 String
016 Blanket
017 Bowl
018 Slope
019 Veneer

Fen
001 Northern Ribbed
002 Atlantic Ribbed
003 Ladder
004 Net
005 Floating
006 Stream
007 Shore
008 Collapse
009 Palsa
010 Spring
011 Slope
012 Lowland Polygon
013 Horizontal
014 Channel

Swamp
001 Stream
002 Shore
003 Peat Margin
004 Basin
005 Flat
006 Floodplain
007 Spring

Marsh
001 Estuarine High
002 Estuarine Low
003 Coastal High
004 Coastal Low
005 Floodplain
006 Stream
007 Channel
008 Active Delta
009 Inactive Delta
010 Terminal Basin
011 Shallow Basin
012 Kettle
013 Seepage Track
014 Shore

Shallow Water
001 Stream
002 Channel
003 Oxbow
004 Delta
005 Terminal Basin
006 Shallow Basin
007 Kettle
008 Shore
009 Nontidal
010 Estuarine
011 Tidal

Wetland Type

(0.01) Coniferous
0.02 Hardwood
0.03 Tall Shrub
0.04 Low Shrub
0.05 Mixed Forb
0.06 Grass
0.07 Rush
0.08 Sedge
0.09 Moss
0.10 Lichen
0.11 Floating Aquatic
0.12 Submerged Aquatic
0.13 Non-vegetated

SPECIAL NOTES

Site No: M001

HYDROLOGY

ORIGIN OF WATER

(01) Precipitation
02 Ground water
03 Stream water
04 Lake water
05 Brackish water
06 Salt water

TYPE OF ASSOCIATED WATER BODY

(07) Shallow Pond
08 Shallow Lake
09 Lake
10 Water Track
11 Tidal Channel

DEPTH TO WATER TABLE

Max (cm): | Min (cm):

Date:

NO	DATE	DEPTH TO WATER TABLE (cm)

WATER ANALYSIS

NO	LAB NO	pH	CONDUCTIVITY (mmhos/cm)	CATIONS (ppm) Ca	Mg	Na	TOTAL CATIONS (ppm)	ANIONS (ppm) SO_4	Cl	HCO_3	TOTAL ANIONS (ppm)
01	002	4.7	0.05	2.0	0.7	Tr	2.7	Tr	Tr	Tr	Tr
02											
03											
04											
05											
06											
07											
08											
09											
10											
11											
12											

TYPE OF WATER USED FOR ANALYSIS

	1	2	3	4	5	6
Ground water	—					
Stream water						
Lake water						
Tidal water						
Soil water						

SPECIAL NOTES

Site No. M001

SOIL

MORPHOLOGY

NO	LIT DIS	MASTER LAYER/ HORIZON	SUFFIXES	MODIFIER	DEPTH (cm) UPPER LIMIT	LOWER LIMIT	COLOR ASPECT	HUE	SYMBOL	VALUE	CHROMA
01		O	f		0	51	m	7·5	YR	5	4
02		O	mz		51	188	m	10	YR	3	2
03		O	hz		188	293	m	10	YR	3	1
04	II	C	gz		293	517	m	5	Y	6	1
05	II	C	g		517	525	m	5	Y	6	1
06											
07											
08											
09											
10											
11											
12											

COLOR ASPECT
m - moist
d - dry
f - frozen

PEAT AND LIMNIC MATERIALS

	1	2	3	4	5	6
Sphagnum Peat						
Brown Moss-Fen Peat						
Sedge-Fen Peat			—			
Woody-Fen Peat						
Woody-Forest Peat						
Feather Moss-Forest Peat	—	—				
Lichen-Forest Peat						
Aquatic Peat						
Mixed Peat						
Marl			—			
Coprogenous earth						
Diatomaceous earth						

TEXTURE

MINERAL	1	2	3	4	5	6
Sand						
Loamy Sand						
Sandy Loam						
Loam						
Silt Loam						
Silt						
Sandy Clay Loam						
Clay Loam						
Silty Clay Loam						
Sandy Clay						
Silty Clay				—	—	
Clay						
Heavy Clay						

ORGANIC	1	2	3	4	5	6
Fibric	—					
Mesic		—				
Humic			—			

CLASSIFICATION

ORGANIC
01 Typic Fibrisol
02 Mesic Fibrisol
03 Humic Fibrisol
04 Limno Fibrisol
05 Cumulo Fibrisol
06 Terric Fibrisol
07 Terric Mesic Fibrisol
08 Terric Humic Fibrisol
09 Hydric Fibrisol
10 Typic Mesisol
11 Fibric Mesisol
12 Humic Mesisol
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18 Hydric Mesisol
19 Typic Humisol
20 Fibric Humisol
21 Mesic Humisol
22 Limno Humisol
23 Cumulo Humisol
24 Terric Humisol
25 Terric Fibric Humisol
26 Terric Mesic Humisol
27 Hydric Humisol

GLEYSOLIC
28 Orthic Humic Gleysol
29 Rego Humic Gleysol
30 Fera Humic Gleysol
31 Orthic Gleysol
32 Rego Gleysol
33 Fera Gleysol
34 Orthic Luvic Gleysol
35 Humic Luvic Gleysol
36 Fera Luvic Gleysol
37 Fragic Luvic Gleysol

CRYOSOLIC
38 Fibric Organic Cryosol
39 Mesic Organic Cryosol
40 Humic Organic Cryosol
41 Terric Fibric Organic Cryosol
42 Terric Mesic Organic Cryosol
43 Terric Humic Organic Cryosol
44 Glacic Organic Cryosol
45 Gleysolic Turbic Cryosol
46 Gleysolic Static Cryosol

SPECIAL NOTES

Site No. M001

SOIL ANALYSIS

Chemical Analysis

NO	LABORATORY SAMPLE NO	PH 1 VALUE	PH 2 VALUE	ORGANIC CARBON (%)	PYROPHOSPH SOL (%)	TOTAL NITROGEN (%)	ELECTRICAL CONDUCTIVITY (mmhos/cm)	CEC (me/100g)	EXCHANGEABLE CATIONS (me/100g) Ca	Mg	Na	K
01	0071	39		514	5	11		1914	899	155	02	04
02	0072	57		494	4	16		1934	1355	176	03	02
03	0073	71		434	1			1183	1822	157	03	02
04	0074											
05	0075											
06												
07												
08												
09												
10												
11												
12												

Physical Analysis

NO	PARTICLE SIZE ANALYSIS (%) OF SAMPLE VC SAND	C SAND	MED SAND	F SAND	VF SAND	TOTAL SAND	70-2u SILT	50-2u SILT	2u CLAY	0.2u CLAY	BULK DENSITY (g/cc)	MOISTURE (%)	ICE (%)	RUBBED FIBRE (%)	UNRUBBED FIBRE (%)	ASH (%)
01											007	45		70	92	11
02													96	31	41	
03											015		90	8	31	36
04						2	9		89							
05						1	10		89							
06																
07																
08																
09																
10																
11																
12																

SPECIAL NOTES

Tr: LESS THAN 0·1%

pH

pH value 1
Sample state
T 021 Field state
T 022 Air dry

Method
T 031 Water 1:1
T 032 Water 1:5
T 033 Water saturated
T 034 Calcium chloride
T 035 Potassium chloride
T 036 Sodium fluoride

pH value 2
Sample state
T 041 Field State
T 042 Air dry

Method
T 051 Water 1:1
T 052 Water 1:5
T 053 Water saturated
T 054 Calcium chloride
T 055 Potassium chloride
T 056 Sodium fluoride

EXCHANGEABLE CATIONS

Neutral salt
Extractant
T 141 $CaCl_2$
T 142 KCl
T 143 NaC
T 144 $BaCl_2$
T 145 K_2SO_4

Analytical Procedure
T 151 EDTA titration
T 152 Phosphate titration
T 153 EtOH titration
T 154 Aluminon titration
T 155 Flame photometry
T 156 Atomic absorption
T 157 Auto-analyzer

CATION EXCHANGE CAPACITY

Permanent charge
T 121 Neutral salt long method
T 122 Neutral salt rapid method

ORGANIC CARBON

T 061 Dry combustion induction furnace
T 062 Wet oxidation (Allison)
T 063 Wet oxidation (Walkley-Black)
T 064 Dry combustion resistance furnace
T 065 Pyrophosphate soluble

TOTAL NITROGEN

T 071 Semi-micro NO_3 & NO_2 included
T 072 Semi-micro NO_3 & NO_2 not included
T 073 Macro Kjeldahl NO_3 & NO_2 included
T 074 Macro-Kjeldahl NO_3 & NO_2 not included
T 075 Micro-Kjeldahl
T 076 Nitrogen analyser

RUBBED FIBRE

T 501 Visual estimate
T 502 Syringe
T 503 Gravimetric

UNRUBBED FIBRE

T 511 Visual estimate
T 512 Syringe
T 513 Gravimetric

PERCENT ASH

T 521 Dry ashing
T 522 Wet ashing

PARTICLE SIZE ANALYSIS

Pretreatment-
Removal of
T 531 Carbonates
T 532 Organic matter
T 533 Iron oxides
T 534 Soluble salts

Dispersion
T 541 Sodium hexametaphosphate
T 542 Sodium hydroxide
T 543 Sonic

Method
T 551 Pipette
T 552 Hydrometer
T 553 Plummet
T 554 Decanting
T 555 Ultra sonic sieving
T 556 X-ray
T 557 Wet sieving

BULK DENSITY

Sample state
T 561 Field state
T 562 Air dry
T 563 Oven dry
T 564 30 cm absorption
T 565 1/3 bar desorption

Organic soils
T 581 Core samples
T 582 McCauley peat auger samples
T 583 Steel-pin sampling board

PYROPHOSPHATE SOLUBILITY

T 940 Visually read
T 941 Spectrophotometer

VEGETATION

Site No. M001

Vegetation Type: BLACK SPRUCE-CLADONIA

Plot Size (m²)	1
Tree Cover (%)	25
Tall Shrub (> 1.5 m) Cover (%)	2
Medium Shrub (0.5 – 1.5 m) Cover (%)	
Low Shrub (0.1 – 0.5 m) Cover (%)	
Ground Shrub (< 0.1 m) Cover (%)	
Herb Cover (%)	
Moss and Lichen Cover (%)	
Submergent and Floating Cover (%)	

Exposure: 1. Minimal 2. Moderate 3. Severe
Homogeneity: 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief: 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
Picea mariana	3				
Salix bebbiana		1			
Cladonia mitis				3	
Cladonia rangiferina				3	
Cladonia alpestris				4	
Cladonia uncialis				1	
Cladonia cornuta				1	
Ptilidium pulcherrimum				1	

Tree Data

SPECIES NAME	HEIGHT (m)	D.B.H (cm)	AGE (years)	CROWN CLASS
Picea mariana	3·5	10	144	Dom.

SPECIAL NOTES

OPENINGS OCCUPY ABOUT 27% OF THE AREA WHERE LEDUM GROEN-LANDICUM, VACCINIUM VITIS-IDEA AND CHAMAEDAPHNE CALYCULATA GROW IN A DENSE CARPET OF REINDEER LICHEN.

VEGETATION

Site No. M001

Vegetation Type: BLACK SPRUCE-FEATHER MOSS

Plot Size (m²)	1
Tree Cover (%)	87
Tall Shrub (> 1.5 m) Cover (%)	4
Medium Shrub (0.5 – 1.5 m) Cover (%)	10
Low Shrub (0.1 – 0.5 m) Cover (%)	5
Ground Shrub (< 0.1 m) Cover (%)	
Herb Cover (%)	
Moss and Lichen Cover (%)	80
Submergent and Floating Cover (%)	

Exposure: 1. Minimal 2. Moderate 3. Severe
Homogeneity: 1. Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief: 1. Plane 2. Convex 3. Concave 4. Microridge 5. Hummocky 6. Undulating 7. Other

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
Picea mariana	6				
Betula papyrifera	1				
Larix laricina	1				
Salix bebbiana		1			
Ledum groenlandicum		2			
Vaccinium vitis-idaea		1			
Ptilium crista-castensis				4	
Dicranum rugosum				2	
Pleurozium schreberi				4	
Peltigera aphthosa				1	
Cladonia rangiferina				2	
Cladonia mitis				2	

Tree Data

SPECIES NAME	HEIGHT (m)	D.B.H (cm)	AGE (years)	CROWN CLASS
Picea mariana	4·25	9	76	
Betula papyrifera	3·50	—	—	

SPECIAL NOTES

A FULL CARPET OF FEATHER MOSSES COVERS THE GROUND. THE GRO-UND IS BARE, HOWEVER, WHERE TREE DENSITY EXCEEDS FOUR TREES PER m². OPENINGS OCCUPY ABOUT 19% OF THE AREA WHERE LEDUM GROENLANDICUM AND VACCINIUM V-I GROW WITH MOSS AND CLADONIA.

VEGETATION

Site No M 0 0 1

Vegetation Type S P H A G N U M

Plot Size (m²) 1

Tree Cover (%)

Tall Shrub (> 1.5 m) Cover (%)

Medium Shrub (0.5 – 1.5 m) Cover (%) 1 0

Low Shrub (0.1 – 0.5 m) Cover (%) 2

Ground Shrub (< 0.1 m) Cover (%)

Herb Cover (%)

Moss and Lichen Cover (%)

Submergent and Floating Cover (%)

Exposure: 1. Minimal 2. Moderate 3. Severe
Homogeneity: 1 Continuous 2. Discontinuous 3. Patchy 4. Rare
Microrelief: 1 Plane 2. Convex 3. Concave 4. Microridge 5 Hummocky 6. Undulating 7. Other

SPECIES NAME	TREES COVER SOC	SHRUBS COVER SOC	HERBS COVER SOC	MOSS AND LICHENS COVER SOC	SUBMERGENT AND FLOATING COVER SOC
LEDUM GROENLANDICUM		2			
Chamaedaphne calyculata		1.			
Oxycoccos microcarpus		1			
Rubus chamaemorus		1			
Empetrum nigrum		1			
Sphagnum fuscum				7	
Hylocomium splendens				1	
Dicranum bonjeani				1	

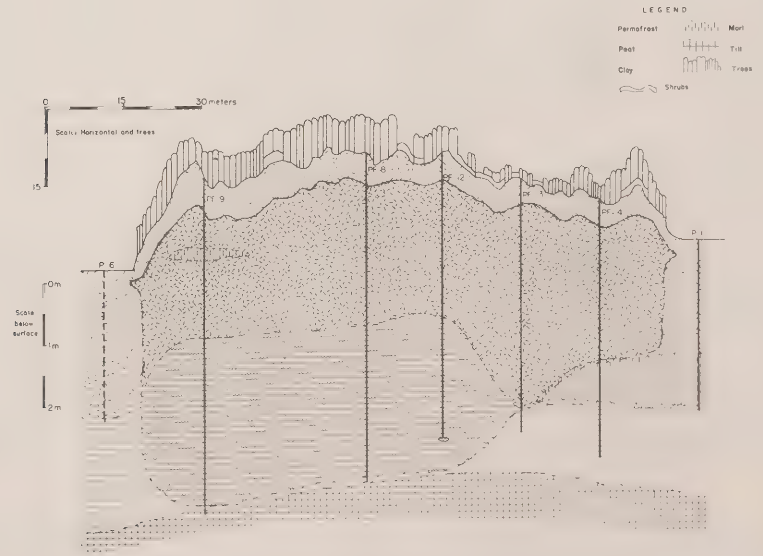
Tree Data

SPECIES NAME	HEIGHT (m)	D.B.H. (cm)	AGE (years)	CROWN CLASS

SPECIAL NOTES

MAPS AND CROSS-SECTIONS

Site No. M 0 0 1



Cross section of palsa along center line, showing permafrost core and thickness of active layer in relation to vegetation cover.

N.T.S. 63K Scale 1:250 000

Map of palsa complex showing surface contours, survey lines, and location of sampling sites. Permafrost boundary approximates the 75-cm contour.

Stereo triplet showing the location of the palsa site (A) on the east side of the highway. The site is located approximately 8 km south of Cranberry Portage, Manitoba.

REFERENCES

Site No. M001

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COASTAL SALT MARSHES IN CANADA

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ABSTRACT

The vegetation, hydrology, and distribution of salt marshes in Canada's Pacific, Atlantic, Subarctic and Arctic coastal areas are presented in this review of existing literature. Extensive research remains to be done on the ecology of salt marshes and on the physiology of the flora found there. In particular, salt marshes near urban centres are under severe development pressures; yet are neglected in terms of basic research. This may have long-term effects on shorezone ecology, local fisheries as well as waterfowl and shorebird populations.

RÉSUMÉ

La présent étude bibliographique est une introduction à la végétation, à la hydrologie et à la répartition des schorres du Pacifique, de l'Atlantique, de l'Arctique et des régions subarctiques du Canada. Beaucoup de recherches restent à faire sur l'écologie de ces écosystèmes et sur la physiologie des plantes qu'on y trouve. Ce sont particulièrement les schorres situées près de centres urbains qui sont le plus menacées et pourtant elles sont les plus négligées des chercheurs. A long terme, ceci peut avoir des répercussions sur l'écologie du littoral, les pêheries locales et sur les populations aviaires, y compris la sauvagine.

INTRODUCTION

Coastal salt marshes are areas of land bordering on the sea, more or less covered with vegetation, and subject to periodic innundation by the tide (Chapman, 1974); they may border coastal environments which are saline, brackish, or freshwater such as bays and estuaries (Frey and Basan, 1978). Salt marsh ecosystems represent a complex interaction between chemical, geological, hydrological, oceanographic and biological processes. The vegetation of such ecosystems is adapted to increased sediment or soil salinities, however no evidence exists that plant species growing in salt marshes are obligate halophytes, and relatively very few species tend to be facultative halophytes. In general, the ability to reproduce under saline conditions is probably the ultimate criterion for salt tolerance (Barbour, 1970).

Geologically, salt marshes develop on stable or emerging shorelines such as the coast of James and Hudson Bay. In submerging coastlines such as the Gulf of Mexico and Atlantic coasts, sedimentation rates must equal or exceed subsidence rates for these ecosystems to develop. Types of coastal environments favoring salt marsh development include (1) estuaries, (2) sheltered areas including spits, lagoons, offshore bars, and islands, (3) protected bays and inlets, (4) deltas, and (5) open coasts characterized by low wave energy activity, i.e. the large expanses of shallow tidal flats in James Bay (Glooschenko and Martini, 1978). On a world basis, large salt marsh complexes include the English coast, European river mouths, the Baltic coast, the Atlantic and Gulf of Mexico coasts of the United States, and the shores adjacent to the Hudson Bay Lowlands (Chapman, 1974). On tropical coasts, the salt marsh is replaced by the mangrove ecosystem, however, a tropical salt marsh may occur in some areas.

In terms of temperate North America (excluding Mexico), 80-90% of the east coast is suitable for salt marsh development while only 10-20% of the west coast has the proper physiography (Frey and Basan, 1978). This is due to the active tectonic nature of the west coast which is characterized by deep fjords in British Columbia and southern Alaska and relatively few protected bays and small lagoons in California, Oregon and Washington. For example, from Texas to New York, approximately 2 x 10^6 ha of salt marshes are present, while on the Pacific coast, only several thousand ha are present according to Frey and Basan (1978).

Canada's major salt marshes include the Maritimes (especially the Bay of Fundy region), southern B.C. adjacent to the Fraser River mouth, and the low-energy coastline of the Hudson Bay Lowlands in parts of Quebec, Ontario, and Manitoba south of Churchill. Based upon

the North American classification of Frey and Basan (1978), Canada's salt marshes can be divided into four phytogeographic types: (1) Central Pacific Coast marshes, (2) West Alaskan and subarctic marshes, (3) Arctic marshes, and (4) Bay of Fundy marshes. They leave a blank for marshes of Newfoundland, the adjacent Gulf of St. Lawrence area, and parts of Labrador due to a lack of literature. For purposes of this paper, Canada's coastal salt marshes will be classified into three main types: (1) Pacific Coast salt marshes, (2) Atlantic salt marshes, and (3) Subarctic and Arctic salt marshes. Unfortunately, little is known of the areal extent of these salt marshes in Canada. Such a differentiation is based upon differences in species composition of major vegetation species. The Pacific Coast salt marshes are limited to protected inlets, the heads of fjords, and the Fraser River delta area. Vegetation of these marshes consists of a mixture of subarctic/arctic salt marsh plants at their southern limits, and floral elements characteristic of the temperate Pacific coast at their northern limit. Near river mouths, large brackish marshes are dominated by *Carex lyngbyei*. In terms of geographic extent, the Subarctic and Arctic salt marshes, dominated by the grass *Puccinellia phryganodes*, is the major salt marsh system of Canada extending north from Labrador into the Arctic islands, to Hudson and James Bay, and to the Alaska border. The Maritime salt marshes are dominated by *Spartina alterniflora*, the major salt marsh species of the Atlantic and Gulf of Mexico coasts, along with other species found in northern salt marshes of the world, especially in adjacent New England. This paper will discuss each of these three main salt marsh types in detail.

PACIFIC COAST SALT MARSHES

The coastline of British Columbia is tectonically active, modified by glacial activity and subsequent submergence due to sea-level rise. Such a coast is not conducive to salt marsh development, which, as previously discussed, is more frequent on low-energy coasts with extensive tidal flat development such as the Boundary Bay region of southern B.C. or bays and other inlets and deltas such as at the Fraser River mouth. In British Columbia, such suitably protected areas may also occur at the heads of fjords receiving large amounts of freshwater input from rivers, and marshes that develop at such sites are characterized by either freshwater or brackish water vegetation, mainly *Carex lyngbyei*, as opposed to true salt marsh vegetation. A good example of this in British Columbia that has been characterized in the literature are the brackish marshes found at the mouth of the Squamish River (Lim and Levings, 1973; Levings and Moody, 1976). Unfortunately, a coastal marsh inventory does not exist for British Columbia and, other than the Vancouver area, the only other salt marsh data available in the literature are for the Queen Charlotte Islands (Calder and Taylor, 1968).

The most extensive tidal marsh area of British Columbia extends from the Fraser River delta southward to the Point Roberts peninsula and Boundary Bay to Crescent Beach at the Canada-U.S. border. The extent of such marshes is 27 km^2 (Kistritz, 1978). Two main environments occur: (1) the freshwater tidal marshes in the channels of the Fraser River and brackish marshes where dilution of Georgia Strait waters by the Fraser River plume occurs, and (2) the salt marshes where no Fraser River influence is present, i.e. the Tsawwassen area south of the Roberts Bank Coal Port Causeway and Boundary Bay salt marshes.

The freshwater/brackish marsh system of the Fraser delta shows a zonation typical of coastal marshes, and has been described by several authors including Burgess (1970), Forbes (1972), McLaren (1972), Yamanaka (1975), and Moody (1978). Offshore in zones of river influence, *Scirpus americanus* occupies the lowest portions of these marshes, with *Scirpus paludosus* and *Carex lyngbyei* found higher in elevation. The upper levels are dominated by *Typha latifolia* indicating a more freshwater ecosystem component. On islands in the river, *Scirpus americanus* does not appear at lower marsh elevations, nor does *Scirpus paludosus* hence these two species tend to be

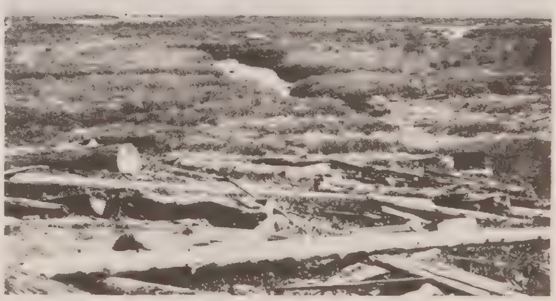

Figure 1: Upper salt marsh located at Boundary Bay, British Columbia with tidal creek in mid-photo. Vegetation is mainly Salicornia virginica and Distichlis spicata.

indicative of brackish conditions. As one goes south of Canoe Pass, which separates Westham Island from the delta area, the Fraser River waters have less of an effect on Roberts Bank saline waters and the brackish species *Scirpus americanus* disappears followed by the removal of *Scirpus paludosus*.

Replacing these two species is the more salt-tolerant *Triglochin maritima* which is the main colonizing species southward to the Tsawwassen area and Boundary Bay. These true salt marshes are characterized by two other dominant species, *Salicornia virginica* and *Distichlis spicata* and such salt marshes have been described by Yamanaka (1975), Hillaby and Barrett (1976), Parsons (1975), and Moody (1978). Most of these salt marshes are fairly narrow being formed on accreted sediments to the seaward of dykes (Kellerhalls and Murray, 1969). In general, these salt marshes tend to be similar in vegetation to marshes located in Oregon, Washington, and the extreme northern part of California (Macdonald, 1977).

The only other salt marshes described in the literature for British Columbia are for the Queen Charlotte Islands (Calder and Taylor, 1968). Here, salt marshes are located in inlets and harbours. Highest salinity marshes are found in areas fronted by shingle beaches or mudflats with such species dominating as *Deschampsia caespitosa, Hordeum brachyantherum, Festuca rubra, Triglochin maritima, Carex lyngbyei, Plantago macrocarpa,* and *Stellaria humifusa.* Brackish marshes are located in areas subjected to river inputs and are characterized by such species as *Triglochin maritima, Puccinellia pumila, Scirpus cernuus,* and *Lilaeopsis occidentalis.* The Queen Charlotte Island marshes appear more similar in species composition to Alaskan subarctic salt marshes (Macdonald, 1977; Crow, 1977), and, in fact, Frey and Basan (1978) have separated the salt marshes of the Pacific Coast of North America into a Central Pacific Coast Marsh zone ending in the Vancouver area, and a West Alaska and Subarctic Marsh Zone which extends north up the coast from Vancouver to Alaska in the region of the Arctic Ocean. The part of British Columbia included here is dominated by fjords which are usually not characterized by salt marsh development, however, brackish and fresh water marshes may be found. The Squamish River delta, an example of a marsh at the head of a fjord, is characterized by such species as *Carex lyngbyei, Eleocharis palustris, Deschampsia caespitosa, Festuca rubra, Hordeum brachyantherum, Potentilla pacifica, Trifolium wormskjoldii, Lathyrus palustris,* and other species (Lim and Levings, 1973; Levings and Moody, 1976). Even though this system is close

Figure 2: Triglochin maritima colonizing intertidal flats near Roberts Bank causeway, B.C.

to the Fraser River delta geographically speaking, its change in vegetation is most likely due to lower temperatures in the fjord (Lim and Levings, 1973).

Much of the recent research on B.C. salt marshes is concerned to primary productivity and nutrient and detritus cycles, especially in relation to salmon fisheries. The reviews by Kistritz (1978) and Dorcey *et al.* (1978) are excellent summaries of this important area. A recent paper by Kistritz and Yesaki (1979) has discussed the question of productivity, detritus and nutrient cycling in a *Carex lyngbyei* marsh located near Vancouver on the Fraser River estuary.

SUBARCTIC AND ARCTIC SALT MARSHES

The largest extent of salt marshes in Canada are located in Arctic and Subarctic regions including the Arctic island, the western and eastern Canadian Arctic, Hudson and James Bay, and Labrador. Polunin (1948) first characterized such Arctic salt marshes as being dominated by the colonizing turf-like grass *Puccinellia phryganodes.* A more recent paper by Jeffries (1977) in Arctic Canada describes a pioneer salt marsh community to be dominated by *Puccinellia phryganodes, Stellaria humifusa,* and *Cochlearia officinalis.* In more sheltered areas, he found other species including *Arctophila fulva, Dupontia fisheri, Hippurus tetraphylla,* and *Carex ramenskii.* In general, these marshes are similar in vegetation composition in other arctic localities including Greenland and northern Europe (Chapman, 1974).

The majority of salt marsh research for subarctic/arctic Canada has been done in Hudson and James Bay area. The western shore of the Hudson and James Bay area is especially favourable for salt marsh development due to its relatively rapid rate of isostatic uplift and large expanse of tidal flats. Also, the presence of beach ridge systems and spits allow for sediment accumulation in low-energy environments and subsequent colonization by vegetation. Polunin (1948) has described the more northern Hudson Bay marshes in northern Quebec, several Hudson Bay islands, and western Hudson Bay at Chesterfield Inlet. Dominant vegetation again included *Puccinellia phryganodes*, several *Carex* species including *C. subspathacea*, *C. ursina*, *C. bipartita* var. *amphigena*, several grasses such as *Dupontia fisheri*, and various herbaceous species. Ritchie (1957) has described a vegetation sequence in the Churchill River estuary in brief detail, and Schofield (1959) has characterized the salt marsh vegetation at Churchill, Manitoba. The dominant plant was *Carex subspathacea*, with other species occuring similar to those described by Polunin (1948) for more northerly marshes. Other important species included various grass, sedge and forb species. Other more recent research on salt marshes near Churchill has been done at La Perouse Bay by Jeffries *et al.* (1979). Where flowing water of the Mast River was present, *Hippurus tetraphylla* was present while on open tidal flats *Puccinellia phryganodes* was the main colonizing species along with *Carex subspathacea*, *Cochlearia officinalis* var. *groenlandica*, and *Potentilla egedii*. Forbs present on more raised areas included *Chrysanthemum arcticum*, *Stellaria humifusa*, *Senecio congestus*, *Plantago maritima* var. *juncoides*, and *Ranunculus cymbalaria*. These salt marshes gave away more inland to *Salix brachycarpa* bushes surrounded by such grasses as *Calamagrostis deschampsioides*, *Hierchlöe pauciflora*, and *Festuca rubra*; later in the succession *Salix candida* and *Salix planifolia* were present. In areas of higher salinity dominant species were *Salicornia europaea*, *Triglochin maritima*, *Plantago maritima* var. *juncoides*, and *Puccinellia phryganodes*. As salinities decreased, fens were present characterized by *Carex glareosa*, *Carex aquatilis*, *Triglochin maritima*, *Eriophorum angustifolium*, *Calamagrostis neglecta*, and *Dupontia fisheri*. These authors found lesser snow geese which feed in the area during summer to play an important role in creating ponds in upper areas of the salt marsh.

Further south at East Pen Island, just below the Ontario/Manitoba border, Kershaw (1976) found the vegetation composition of a salt marsh system quite similar to the marshes described in the Churchill area by the previously mentioned authors; a mid-marsh system behind the salt marsh was characterized by *Dupontia fisheri* and *Calamagrostis neglecta* which gave way to a wide freshwater fen system dominated by *Carex aquatilis*. This occurred behind the first beach ridge. Kershaw attributed this as a function of meltwater runoff from the surface of the permafrost table; however, such fens are found throughout the James Bay Coast where no permafrost occurs so another hydrological phenomena may be occurring.

The western coast of Hudson and James Bay has been the subject of a comprehensive study integrating the disciplines of sedimentology, pedology, geomorphology, vegetation ecology and shorebird and waterfowl ecology (Glooschenko and Martini, 1978). Ontario's approximately 1100 km of shoreline is characterized by extensive salt marsh and brackish marsh development; an estimated 85-90% of the shoreline has such marsh development. Four major coastal ecosystems are present (Glooschenko and Martini, 1978; Glooschenko 1980). The most dominant of these is the *salt marsh*. Even though coastal waters are brackish with salinities less than 1/2 to 1/3 of normal sea water, tidal transport onto the marshes and *in situ* evaporation produces elevated soil salinity. The vegetation of these salt marshes is dominated by such species as *Puccinellia phryganodes*, *P. lucida*, *Salicornia europaea*, *Glaux maritima*, *Scirpus maritimus*, *Triglochin maritima*, *Potentilla egedii*, *Plantago maritima*, *Festuca rubra*, *Juncus balticus*, *Cicuta maculata*, *Carex subspathacea*, *Carex paleacea*, *Hordeum jubatum*, and *Atriplex patula*. Such salt marshes

Figure 3: Puccinellia phryganodes colonization zone in S.W. James Bay salt marsh.

grade into brackish freshwater marshes, fens and old beach ridge communities. Sand dunes are present south of Cape Henrietta-Maria separating James and Hudson Bay.

The second main coastal ecosystem is the river-influenced *brackish marsh*, which is found south of major rivers as predominant currents in the James Bay flow counter-clockwise. These marshes are dominated by such species as *Eleocharis palustris*, *Carex paleacea*, *Hippurus tetraphylla* and *Scirpus maritimus*. These marshes are often "inverted", that is, storm surges transport brackish waters up to several km inland, where restricted drainage can occur. Evaporation leads to increased soil salinity and a more typical salt marsh vegetation can be found inland of the brackish marsh, especially noticeable in the area south of the Attawapiskat River where *Hippurus* dominates, and near the Harricanaw River and Hannah Bay at the south end of James Bay.

The river mouth or *estuarine marsh* occurs in and adjacent to river mouths such as the Moose, Harricanaw, Albany and Attawapiskat Rivers. The vegetation of these is typical freshwater marsh dominated by such species as *Eleocharis palustris*, *Scirpus validus*, *Scirpus americanus*, several species of *Carex*, *Juncus*, and *Potamogeton*. The fourth major system, the *high-energy coastal ecosystem*, is found along rocky promontories and beaches which act as areas of erosion or sediment bypasses. They possess little or no salt or brackish components due to exposure to waves and lack of suitable stable substrate. Such ecosystems

Figure 4: Seaward view of a typical S.W. James Bay salt marsh dominated by Triglochin maritima, Atriplex patula, Plantago maritima and Puccinellia lucida. Note beach ridge in background.

are characterized by subarctic trees and shrubs or, if sandy, by beach grasses, mainly *Elymus mollis* and dune vegetation including *Honkenya peploides* and *Mertensia maritima*. Often, freshwater marshes dominated by *Typha* or fens dominated by *Carex* species are located in depressions landward of these beaches and promontories. However, north of Lake River near Cape Henrietta-Maria, trees disappear, except along rivers and brooks, and such rocky areas, old beach ridges, and dunes have typical tundra vegetation.

The flora of the southwestern portion of James Bay has been discussed by Riley and McKay (1979). Nearly 400 vascular plant species were noted, and the authors have described major plant associations in the area. Of interest was the number of disjunct plant species (31). The authors attributed this to ongoing modes of species dispusal such as bird migration, migration of species through proglacial lake systems from the south, east and west and a possible circumdispersal around the Quebec-Labrador peninsula by east coast species.

Other research along the Ontario shore has emphasized productivity of salt marshes (Glooschenko, 1978), and geomorphology, soils and sediments including invertebrates (Martini and Protz, 1978; Martini *et al.*, 1979). A recent paper by Martini *et al.* (1980) emphasizes the interrelationships between the geological and ecological aspects of a southwestern James Bay salt marsh with emphasis upon shorebirds.

The Quebec shore of James and Hudson Bay has little salt marsh development. This is due to the extention of the Canadian Shield to the coast and subsequent lack of extensive tidal flat development favoring salt marsh development such as occurs on the western coast. Marshes that do occur are found along bays and river mouths such as Rupert Bay (Lamoureux and de Repentigny, 1972; Lamoureux and Zarnovican, 1972; Laverdière and Guimont, 1975), and the Baie aux Oies (Lamoureux and Zarnovican, 1974). Due to large river inputs of freshwater, such marshes show very little true salt marsh components of vegetation. Brackish marshes occur where river influence is less, and such species as *Carex paleacea*, *Scirpus paludosus*, and *Hippurus tetraphylla* are noted. The freshwater marshes are dominated by *Eleocharis* sp., *Scirpus validus*, *Scirpus americanus*, *Calamagrostis neglecta*, *Potamogeton* sp., *Deschampsia caespitosa*, *Carex glareosa* and others. Species tolerant of higher salinities such as *Salicornia europaea*, *Puccinellia lucida*, *Atriplex patula*, and *Suaeda maritima* appear limited to local areas where evaporation of trapped saline water may occur such as in the Cabbage Willow Bay area. No data appear in the

literature for the Hudson Bay coast of Quebec.

Thus, the Arctic and subarctic salt marshes have been described in some detail, and studies are underway on the interplay between geological, hydrological, chemical, and biological factors important in the structure and functioning of these marshes which play an important role as a staging and nesting area for migratory birds.

MARITIME SALT MARSHES

Atlantic Canada represents the northern extension of the vast salt marsh complex of the Gulf of Mexico and the east coast of the United States (Chapman, 1974; Reimold, 1977). These marshes are dominated by *Spartina alterniflora* and *Spartina patens*, which do not occur in other Canadian salt marshes. Probably, the most detailed study of such marshes is Ganong's (1903) classical study of the Bay of Fundy salt marshes. He recognizes three main vegetative components: (1) the halophytic division, (2) the mesophytic division, and (3) the hydrophytic division. The halophytic division is the true undisturbed salt marsh. The lower portion, subjected to tidal innundation of the marsh and tidal creeks, is characterized by *Spartina alterniflora* (his *Spatina stricta*). The higher portions of the salt marsh is characterized by *Spartina patens*, *Limonium carolinianum*, *Salicornia europaea*, *Suaeda linearis*, *Atriplex patula*, *Plantago maritima*, *Puccinellia maritima* (probably *Puccinellia lucida*), *Triglochin maritima*, *Glaux maritima*, *Hordeum jubatum*, and other common species. Note that many of these plants occur in Arctic and subarctic marshes and are not found south of the New England area (Reimold, 1977). Of Ganong's other two marsh types, the mesophytic division refers to areas influenced by man through grazing and cultivation, and the hydrophytic division consists of freshwater marshes and bogs landward of the salt marshes. Chapman (1937) has further studied Nova Scotia salt marshes and pointed out several features not noticed by Ganong. For example, *Juncus balticus* and *Juncus gerardii* occur on the high salt marsh and represent a transition to freshwater components. He also clarified the role of human harvesting of salt marsh grasses and the resultant successional trends.

Further north in Cape Breton Island, Nichols (1918) describes salt marshes. A similar vegetation composition for the Bay of Fundy marshes was noted, but several species were present here of a more northern affinity that were not noted in the Bay of Fundy area: these included *Scirpus paludosus* and *Stellaria humifusa* amongst others.

The St. Lawrence River estuary salt marshes downstream of Quebec City were discussed by Reed and Moisan (1971). A typical marsh consisted of a *Spartina alterniflora* lower salt marsh giving way landward to a *Spartina patens* zone, a *Juncus balticus*-*Juncus gerardii* upper salt marsh with a freshwater marsh system landward of it. In all salt marsh zones, pans were present characterized by *Salicornia europaea*, while ponds with *Ruppia maritima* were found in the *Spartina patens* zone. An overlapping forb complex also was found in the salt marsh, consisting of similar forbs found in the Bay of Fundy system.
Grandtner (1966) has discussed the salt marsh vegetation of the Iles-de-la-Madeleine in the Gulf of St. Lawrence. Vegetation was quite similar to the St. Lawrence estuary marshes except he did not report *Spartina patens*. He also noted *Salicornia europaea* dominating the mud flats.

Within Prince Edward Island and New Brunswick in the southern Gulf of St. Lawrence, salt marshes typically develop on sandy substrates in the lee of barrier island formations (Lucas, 1980). The zonation is also charactistic of estuarine and bay marshes although the latter forms tend to grade into freshwater wetlands dominated by *Phragmites communis* and *Typha latifolia*. Three obvious zones exist within the marsh complex, each associated with a dominant species. The low marsh formation, found both on the shore and in wet depressions within the marsh boundaries is flooded at least daily and dominated by *Sparitina alterniflora*. Growth is neither dense nor vigorous although creek and pan marginal locations exhibit increased production. *Salicornia europaea*, *Suaeda* spp., and *Atriplex patula* are commonly found in association in highly saline substrates above standing water and out of reach of erosive wave action. On higher bare regions of this community and low areas of the next, *Triglochin maritima*, *Plantago juncoides*, and *P. oliganthos* are common.

Spartina patens is the dominant in the meadow or high marsh, above the height of daily surface flooding. At the lower edge of the marsh *S. patens* grows most densely. Density decreases landwards as the marsh height increases and species numbers increase. Associated species include *Potentilla anserina*, *Glaux maritima*, *Scirpus americanus*, *Eleocharis* spp., *Carex paleacea* and *Scirpus maritimus* (in water filled pans). At the meadow fringe these species give way to a grass-rush community of *Festuca rubra*, *Poa palustris*, *Agrostis alba*, *Puccinellia maritima*, and *Juncus gerardii*. *Limonium carolinianum* and *Solidago sempervirens* appear throughout the meadow and occassionally

into the low marsh on the sandier and well-drained substrates.

Well above the range of highest tides, *Juncus balticus* fringes the meadow. Associated with this community are *Aster* spp., *Convolvulus sepium*, *Iris* spp., (*I. ltookeri* and *I. versicolor*) *Trifolium* spp., (*T. arvense*, *T. agrarium*, *T. procumbens*), *Ranunculus cymbalaria*, and *Vicia americana*. Locally within the marsh where freshwater inputs are high *Spartina pectinata*, *Typha latifolia* and *Scirpus validus* stands are common.

More recent research on Atlantic salt marshes has emphasized primary productivity and nutrient cycling. The research studies include the work of Hatcher and Mann (1975), Morantz (1976), and Hatcher (1976). As for Newfoundland and Labrador, no research has been published, and one would expect a transition zone with subarctic or arctic species occurring and more southerly species either absent or less in abundance.

CONCLUSIONS

The literature pertaining to Canadian salt marshes is sparse. Of some 40 papers found by the author, six were published before 1959, and 23 since 1975. Much of the literature is not available in journals, but consists of theses and government reports which often are hard to find. Thus, the author would appreciate additional references that he may have omitted.

Several apparent gaps in Canadian salt marsh research are noted. In terms of geographic distribution, the Pacific and Subarctic/Arctic salt marshes have roughly similar numbers of publications (15 and 18 respectively) with nine for the Atlantic coast. The lack of vegetation information for Newfoundland and Labrador merits future studies in that region, both descriptive and process-oriented. The same applies to the British Columbia coast north of Vancouver. A lack of information exists in regards to hydrology in such wetlands, especially vegetation structure in respect to tidal regimes and storm surge events. Little is known of salt marsh evolution and the relationship between geomorphology and salt marsh development needs further research.

An understanding of the ecology of salt marshes also requires knowledge of the physiological ecology of plant species found in such environments. Such information is non-existent under Canadian conditions. Also, there is still a question on the importance of salt marshes to local fisheries, waterfowl and shorebirds. More is needed on salt marsh food chains to solve such problems.

In conclusion, Canadian salt marshes have been neglected in terms of research, yet marshes near populated areas such as Vancouver, are subject to tremendous development pressures. Even an inventory of extent of Canadian salt marshes is lacking. More research is necessary on these important ecosystems.

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UNITED STATES NATIONAL WETLAND CLASSIFICATION WITH POSSIBLE APPLICATIONS TO WILDLIFE HABITAT

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ABSTRACT

A new hierarchical classification of wetlands and deep-water habitats of the United States has been completed and submitted for publication. Wetland definition, lack of baseline data and application to remote sensing were severe problems during development. The classification is easily related to existing classifications in use in the United States and Canada, although there are differences among classifications. This classification can be used for evaluation of wildlife habitat, but only with supplementary ecological data that relate the needs of individual species to wetland environments. In the future classifications will probably trend toward integrated component systems that will include wetland.

RÉSUMÉ

Une nouvelle classification hiérarchique des terres humides et des habitats d'eau profonde des États-Unis a ét menée à terme et soumise pour publication. Son élaboration s'est butée à de sérieux problèmes en ce qui a trait à la définition des terres humides, au manque de données de base et à son application à la télédétection. Elle peut être facilement reliée aux classifications existantes qui sont utilisées aux États-Unis et au Canada, bien qu'il y ait des différences entre celles-ci. La nouvelle classification peut servir à évaluer les habitats fauniques à condition qu'on y adjoigne des données écologiques complémentaires qui relient les besoins des diverses espèces aux zones humides. Les classifications de l'avenir s'orienteront probablement vers des systèmes intégrés de composantes qui comprennent les terres humides.

INTRODUCTION

I would like to thank the National Wetland Working Group for the opportunity to participate in this seminar. I will give a brief resume of the new classification and furnish some perspective on its development, its relationship to earlier classifications, and its potential uses and limitations for evaluation of wildlife habitat in the central plains of the United States and Canada. The system has been under development since 1975 and has appeared in three preliminary drafts. The final draft, which incorporates some of the ideas gained in a lengthy review process as well as the thinking of my coauthors, Virginia Carter, Frank Golet, and Ted LaRoe, has just been submitted for publication.

When I first came to the Dakotas, Stewart and Kantrud (1971) were putting the final touches on their classification of natural ponds and lakes in the glaciated prairie region in the United States. At the same time I was assigned to a waterfowl research project in central Minnesota. I needed a classification for evaluating waterfowl habitat. The only national classification available, Martin et al (1953), did not include sufficient detail for my purpose and an attempt to apply the Stewart and Kantrud classification outside its intended region was not successful. I, therefore, developed a single-purpose regional classification to meet my needs (Cowardin and Johnson 1973). Similar problems have led to the development of hundreds of different classification systems each with different purposes, structure, and definitions.

At the same time that the events above were taking place, the U.S. Fish and Wildlife Service was making plans to initiate an inventory of wetlands to update the inventory reported by Shaw and Fredine (1956). I was assigned the task of developing a classification that could be used for the new inventory and that would serve as a single system throughout the United States. Nelson et al

(1978:644) recognized the complexity and perhaps futility of multipurpose national classifications but they stressed the need for compatibility: "A generally accepted premise is that no one system is likely to prove suitable for all purposes. But compatibility of information is worthy of continual consideration."

NEW U.S. CLASSIFICATION OF WETLANDS AND DEEP-WATER HABITATS

The classification document (Cowardin et al, in press) is lengthy and contains numerous detailed definitions. The best that I can do in the time available is to give a brief sketch of its structure.

We defined wetlands thus:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by water at some time during the growing season of each year.

This definition is similar in content to definitions in most other wetland classifications but we have extended the classification to include both wetlands and what we have termed deep-water habitats, because in large water bodies such as lakes, rivers, and estuaries, the deep water is intimately related to the shallow vegetated areas that have traditionally been called wetlands.

The classification is hierarchical (Figure 1) beginning at the most general level with five systems: (1) Marine, (2) Estuarine, (3) Riverine; (4) Lacustrine, and (5) Palustrine. All of the systems except the Palustrine are divided into subsystems such as Subtidal, Intertidal, Littoral, and Limnetic, according to traditional ecological concepts.

Classes based on life forms of vegetation for vegetated wetlands and physiography and composition of the substrate for unvegetated wetlands are subordinant to the systems and subsystems. The systems are important in organizing a vast array of wetland data at the national level. The classes are crucial to more detailed applications and form the basic units for wetland inventory and mapping. The classes are divided into subclasses based on more detailed characteristics of life form and substrate material than those used in defining classes.

Dominance types based on the dominant plant and animal species form the lowest level of the classification hierarchy. Dominance types are necessary at the most detailed level of application and also provide essential information for cross-referencing our system to many other published systems.

To classify a wetland at the class level and below, we use modifying terms for water regime, water chemistry, soils and special modifiers for man-made disturbance. In some cases the modifying terms (i.e. soil, water chemistry) are components that were borrowed from existing hierarchical classifications and are integrated across the hierarchy as illustrated by Davis and Henderson (1978).

CLASSIFICATION PROBLEMS

A discussion of some of the problems encountered during construction of the classification will help illustrate the what and why of the system. I hope that this will clarify its potential uses and limitations. Problems and conflicts arose at many stages in the development including: definition of terms, description of the elements to be classified, knowledge of the elements to be classified, and practical application of the system.

Wetland is a man-made concept applied to a portion of an ecological continuum. There may be no clearcut break in duration of flooding, water content of the soil, plant community, or any other attribute that has been used to bound wetland at either the dry or wet end. The problem is further compounded by the fact that people with different purposes, training, or regional background have different ideas as to where the concept should be bounded. How many hours have been spent in futile "Yes it is - No it isn't" arguments on this subject? Yet for administrative and frequently legal reasons a definition must be stated.

We attempted a middle of the road definition and tried not to stray too far from earlier published definitions. To lend some substance to this elusive concept, we stated our definition in terms of hydrophytes and hydric soils. Lists of plants and soils are being prepared by the U.S. Fish and Wildlife Service and the U.S. Soil Conservation Service.

A problem related to definition is the description of the elements to be classified. Two different approaches have been taken in

WETLANDS AND DEEP-WATER HABITATS

System	Subsystem	Class
Marine	Subtidal	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Reef
	Intertidal	Aquatic Bed; Reef; Rocky Shore; Unconsolidated Shore
Estuarine	Subtidal	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Reef
	Intertidal	Aquatic Bed; Reef; Streambed; Rocky Shore; Unconsolidated Shore; Emergent Wetland; Scrub/Shrub Wetland; Forested Wetland
Riverine	Tidal	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Rocky Shore; Unconsolidated Shore; Emergent Wetland
	Lower Perennial	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Rocky Shore; Unconsolidated Shore; Emergent Wetland
	Upper Perennial	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Rocky Shore; Unconsolidated Shore
	Intermittent	Streambed
Lacustrine	Limnetic	Rock Bottom; Unconsolidated Bottom; Aquatic Bed
	Littoral	Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Rocky Shore; Unconsolidated Shore; Emergent Wetland
Palustrine		Rock Bottom; Unconsolidated Bottom; Aquatic Bed; Unconsolidated Shore; Moss/Lichen Wetland; Emergent Wetland; Scrub/Shrub Wetland; Forested Wetland

Figure 1: Classification hierarchy of wetlands and deep-water habitats showing systems, subsystems and classes. The palustrine system does not include habitats. After Cowardin et al (1979).

wetland classification: (1) Areas with uniform hydrologic, edaphic, and vegetative features have been used as the element classified. (2) Entire basins such as prairie potholes, beaver ponds, or sink holes have been used as the elements classified. The second method has been most common in the glaciated prairies of Canada and the United States but is not practical for rivers, lakes and estuaries. We chose the first method because of the necessity to deal with the entire country. Our units are directly equatable to the zones used by Stewart and Kantrud (1971) or Millar (1976), but it is not possible to equate the pond classes or types used in those classifications to any equivalent taxa in ours.

Once the elements to be classified have been delineated, and if attributes for each element are known, the classification process combines the elements into some type of meaningful groupings. Ideally, one would begin the classification process with a list of all the wetlands in the United States. All wetlands would have a list of attributes such as duration of flooding, water chemistry, soil type and plant or animal community. For an effort such as ours, however, no neat lists of attributes existed and the classification effort preceded the data gathering except for a lengthy review of published descriptions from various regional studies. The need for information still exists. Frayer et al (1978) pointed out that the land manager needs information but that classifications provide little information. A land classification system identifies and labels kinds of places and in their words "becomes the basic labeling system for filing data on cases and experiments."

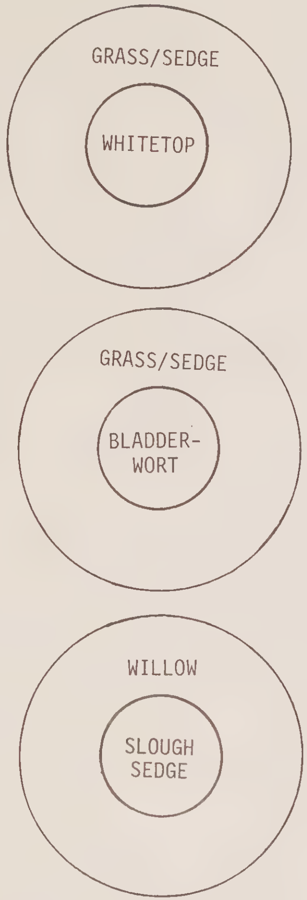
The classification was intended for use in the new inventory of wetlands of the United States. This massive task relies in large part, on data derived from interpretation of aerial photographs. A classification that would work well with remote sensor data such as the one designed by Anderson et al (1976), may have serious disadvantages for users who are interested in making inferences about potential use of an area for various wildlife species. We attempted to shape the hierarchy so that at the class level photointerpretation is possible, but accurate photointerpretation will require highly trained interpreters with knowledge of the ecology of the area and in some cases photography from several flights. Photointerpretation may or may not be possible at the dominance type level in the classification. For example, a peatland community dominated by leatherleaf (*Chamaedaphe calyculata*) might be recognzed. If this is possible, the water regime, water chemistry and soils can perhaps be inferred. Other plant communities, for example aquatic beds in turbid water, defy photointerpretation.

Any classification designed for use with data from remote sensors or for compilation of data on maps must be scale dependent. For example, it is not possible to map and label the thousands of small wetlands in the glaciated prairie region at a scale of 1:100,000. Rather than tie the new classification to a specific map or photo scale, we developed a generalized system that requires the user to make mapping conventions for application at specific scales. A set of mapping rules is being prepared for use in the inventory of wetlands of the United States. These rules give the minimum size wetland to be mapped, set standards for the minimum level of the hierarchy that must be reached, and specify corollary data to be used for such parameters as limit of tidal influence.

RELATIONSHIP TO OTHER CLASSIFICATIONS

This has been a quick summary of the structure of the new classification system and some of the problems encountered in its development. The system is not intended to replace all existing classifications, but it is hoped that it can be used to relate wetlands classified by various other systems. As an example I will relate and contrast the new U.S. system to two systems designed for use in the prairies of the United States and Canada (Stewart and Kantrud 1971; Millar 1976). Both of these systems are designed for basin wetlands typical of glaciated terrain. Both classifications describe zones of vegetation in terms of their dominant plants which were related to water regime and water chemistry. In addition, cover density and interspersion were used to further describe the vegetation. Plant lists typical of various zones of vegetation were prepared.

The difference between these two classifications and the new national system is primarily the order in which the various attributes are used to construct the hierarchy. In both prairie classifications the zones of vegetation, wet meadow, shallow marsh, and deep marsh, were defined in terms of vegetation which was shown to correlate with duration and depth of flooding. The similarity among the three systems is illustrated for three different wetlands each with two distinct zones of vegetation (Figure 2). The correspondence between the water regimes of the new classification and the zones of vegetation in the two prairie classifications is readily apparent. The terms meadow and marsh are both included in the category emergent wetland in the new



	Classification	Outer Zone	Inner Zone
1	Stewart and Kantrud 1971	wet meadow	shallow marsh
	Millar 1976	wet meadow	shallow marsh
	Cowardin et al, 1979	temporarily flooded emergent wetland	seasonally flooded emergent wetland
2	Stewart and Kantrud 1971	wet meadow	shallow marsh (open water phase)
	Millar 1976	wet meadow	transitional open water
	Cowardin et al, 1979	temporarily flooded emergent wetland	seasonally flooded aquatic bed
3	Stewart and Kantrud 1971	not applicable	shallow marsh
	Millar 1976	wet meadow	shallow marsh
	Cowardin et al, 1979	temporarily flooded scrub/shrub wetland	seasonally flooded emergent wetland

Figure 2: Comparison of two classifications used in the prairies (Stewart and Kantrud 1971, Millar 1976) with a new system developed for the United States (Cowardin et al, 1979) for three hypothetical prairie wetlands.

U.S. classification. Both prairie classifications also describe an open water phase for shallow and deep marsh. In the new classification this zone falls in one of three classes: aquatic bed, unconsolidated bottom, or unconsolidated shore with the appropriate water regime modifier.

There is a basic difference between the new classification and the prairie classification with regard to these open water classes. Whereas the prairie classifications pertain to a given year, the new classification refers to long term averages. If an area is open water in a wet year but on the average it contains emergent vegetation it would be classified as emergent wetland in the new classification.

Both prairie classifications also use almost identical systems for describing water chemistry or salinity. The water chemistry modifiers of the new system (based on the Venice system) may be roughly equated as shown by Millar (1976: Fig. 5).

All wetland types discussed thus far occur on mineral soils and for the new classification the appropriate soil modifier would be used. Stewart and Kantrud (1971) describe a fen zone. To describe this type of wetland in the new classification, the soil modifier becomes important. These wetlands would be again classed as emergent wetland but the water regime would usually be saturated and the soil modifier organic (Histosol). In fact some wetlands in the prairies have vegetation similar to fens in boreal peatlands with cover dominated by willows (*Salix* spp.) or bog birch (*Betula pumila*). These wetlands would be classified as scrub/shrub wetland in the new classification but the shrub life form cannot be distinguished in the two prairie classifications. In the transition zone between prairie and forest, the typical emergent species of the wet meadow zone and sometimes the shallow marsh zone are also often replaced by shrubs (Figure 2, Case 3). This zone is called temporarily flooded scrub/shrub wetland in the new classification.

Similar analogies to other regional classifications for specific wetland types such as peatlands (Heinselman 1963), southern swamps (Penfound 1952), or coastal marshes (Redfield 1972) or to national classification (e.g. Shaw and Fredine 1956; Zoltai et al, 1973) may be drawn. The purpose of the classification is not to replace all other classifications but to furnish a single unifying framework and common language that can be used in national inventories and assessments.

EVALUATION OF WILDLIFE HABITAT

The classification alone is of no value for assessing wildlife habitat. It must be combined with information from studies that relate wildlife use to the various attributes of wetland used to construct the classification. For example, Stewart and Kantrud (1973) and Swanson (1973) demonstrated the importance of seasonal ponds for waterfowl. These wetlands produce invertebrates at the time when hens are laying and require high protein food. Given this information we may infer that ponds classified as seasonal form a valuable part of waterfowl habitat.

The classification does not produce any information about the density of wetlands or their relationship to each other and the surrounding upland. This type of information must be derived from inventory and mapping. The relationship between upland and wetland is absolutely essential in evaluating habitat for waterfowl. In the Dakotas, even in areas where drainage or damage to wetlands has been minimal, the quality of waterfowl habitat has been severely degraded by agricultural practices that have denuded the uplands. Therefore, knowledge of wetlands alone does not permit evaluation of waterfowl habitat.

Given an inventory and data base that fully describe an area, it is possible to develop a number of different capability classifications like those used in Canada's Land Inventory Program (Lacate and Romaine 1978). Such classifications are an essential tool for the land manager if he does not lose sight of three potential pitfalls: (1) The predictive capability classes can be no better than the data base from which they were constructed, (2) There are few species where habitat requirements are fully understood, and (3) Capability for production of wildlife varies among species. We frequently hear the terms "good wildlife habitat" or "good waterfowl habitat", but good mallard habitat may be very poor wood duck habitat.

In closing I would like to stress a few points that will probably influence classification efforts in the future. (1) Classification of one part of the environment, "wetland", is artificial and does not necessarily permit inference about land capability even for wildlife. (2) The Manager needs inventory information on what the resource is and where it is. (3) The ecological requirements of wildlife species must be better understood. Even for much-studied groups of species like ducks we cannot always say what is good habitat and what is bad. For less studied species there

frequently are only limited data on species density in relation to habitat.

The basic needs of the manager continue to be inventory of land and water resources and basic ecological studies that clarify the relationship of various organisms to the environment. Classifications serve only to organize this information. As our knowledge increases I suspect that we will see a trend toward integrated component classifications and the development of predictive models designed to aid the manager in making decisions.

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STREAM CLASSIFICATION FOR HABITAT MAPPING

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ABSTRACT

Water regime as a parameter in a wetland classification system is outlined in this paper. Flowing waters in rivers and streams in the prairie-parkland-forest transition region of western Canada are categorized into a spatial hiererchical system defined by fluvial land forms geomorphology, fluvial patterns and vegetation. Water regime is proposed as a major componet of this classification system in association with land forms, substrate, land use and vegetation.

RÉSUMÉ

Une description est donnée du régime hydrologique comme paramètre de classification des terres humides. Les eaux courantes de la région de transition prairie-tourbière-forêt de l'ouest du Canada sont classées selon un système hiérarchique spatial, défini par le relief, leur propre configuration, la géomorphologie des terres qu'elles arrosent et par la végétation. Le régime hydrologique est proposé comme un élément important de ce système de classification en association avec les formes du relief, le sol, l'utilisation des terres et la végétation.

INTRODUCTION

In 1978, the members of the Saskatchewan Wetlands Working Group were asked by its chairman, Dr. Glen Adams, to develop a hierarchical wetland classification using biophysical guidelines for the broad prairie-parkland-transition forest regions of Saskatchewan. The main purpose was to develop a classification system that could be interpreted using values assigned to wetlands for various users' interests in land use planning or scientific studies.

The basic framework of the system proposed was (1) land forms, (2) water regime, (3) substrate, (4) vegetation and (5) land use. As interpreted from the literature, these parameters represent some of the chief controlling agents influencing wetland dynamics. An obvious additional factor is climate, but climatic effects may be prorated to correspond to wetland regions — prairie and parkland. A group of people was charged with the task of deriving the current classification system and developing wetland categories in accordance with assigned levels for each parameter. The water regime parameter group was chaired by J.M. Whiting and the group consisted of L. Bevan, Fisheries, Department of Tourism and Renewable Resources and T. Lackie, University of Saskatchewan. The remainder of this paper deals solely with this parameter: water regime.

TERMS OF REFERENCE

Geographic, Climatic and Hydrological Limitations

The concepts of wetland regions have been explored by Zoltai et al (1975), Jeglum et al (1974), and Cowardin et al (1976), and others. Although no firm boundaries have yet been established, the National Wetlands Working Group plans to follow broad regions proposed by Zoltai et al (1975) based upon forest-climatic boundaries. The Saskatchewan Wetlands Working Group is to consider the regions defined as prairie-parkland by Bird (1961) and Rowe (1972), with some revisions proposed by Millar (pers. comm). The group may also deal with characteristic wetlands located in the transitional forest zone mapped by Zoltai (1975). Wetlands with boreal affinities such as bogs will not be treated by this group. Other restrictions include such man-make water features as reservoirs, sewage ponds and impoundments. Flowing waters and wetlands associated with stream courses or flood plains are to be considered, but large rivers with channel widths in excess of 20 meters, and lakes with mean-mid-summer depths greater than two meters, do not fit our terminology.

Methodology

The following guidelines are proposed for developing a wetland classification.

1. The classification should be oriented to the chief potential users of the system. Therefore, parameters important to hydrological values, land uses, recreation, wildlife and fish habitat, and environmental education should be involved.

2. The classification should follow useful ecological concepts, but be practical and stand up to scrutiny in the field.

3. The classified units should be arranged in a binary key format as presented in Zoltai et al (1975).

4. The classification system should be adaptable to the ecosection approach, using a hierarchical breakdown where possible. For mapping purposes the classification should reflect a spatial hierarchy.

5. Each hierarchical level should be defined according to a single criterion or combination of related criteria where possible. Individual parameters may be further subdivided and occupy more than one hierarchical level.

6. Criteria may change at each hierarchical level in order to give the system flexibility for different uses.

7. The selected criteria should be objective and be detectable from examination of aerial photographs, or from ground inspection. Broader classification levels should be detected from aerial surveys or air photo interpretation.

8. Parameters are not mutually exclusive, and overlap in criteria at different levels may occur. However, such overlap should be minimized. An example is the influence of landform on water dynamics.

9. Consideration should be given to the problem of classifying and mapping dynamic wetland processes, and converting them to artificial stable units (Welch, 1976) while allowing for temporal variability. For example, the classification should account for seasonal water periodicity, successional sequences and nutrient availability.

10. The classification levels should recognize hydroseres and plant successional sequences typical of wetland types within each region. Zonal gradients and seral stages should be identified, but allowance made for transition types.

11. The classification should be sensitive to wetland type differences related to biological productivity or minerotrophy of the sites. These characteristics are probably best expressed in several parameters at a lower hierarchical level.

12. Land use modifications to surface water regimes, vegetative cover, plant succession and wetland soils should be described and categorized. Many basins have been so altered by agricultural practices, that they assume totally different characteristics from natural undisturbed basins.

THE HIERARCHICAL SYSTEM

The flowing water of a stream is first divided by size or volume and then categorized in a spatial hierarchical system defined by land form features. Table 1 presents the organization of the parameters and an outline of the controls for their placement in the stream habitat system. This system is organized to collect information on small streams at spot locations. The system does not identify a reach or segment with relatively homogeneous properties. The volume of flow is the main controlling factor affecting the other parameters. The relative permanency or intermittency of the stream is suggested as another category. The soil textural class and material were suggested as soil parameters rather than soil type as affecting water quality, erodability, etc. Also, water turbidity or colour may be another category below soil-texture, and influencing life forms.

Under the skeletal outline shown in Table 1, the streams are categorized by geomorphology, fluvial patterns, fluvial land forms and life forms. In the geomorphological row, the volume of flow is divided into four groups: soil type, minerotrophy, gradient and the number of changes in slope aspect (or the number of rolls per kilometer). Each of these is broken into five or six sub-classes (Table 1). Some of the visual characteristics are given in Figures 1 to 4. An example of natural turbidity is shown in Figure 5.

The FLUVIAL PATTERNS are joined to all four of the GEOMORPHOLOGY sub-classes. The Fluvial Patterns can be divided into (1) regularity of course, (2) channel distribution pattern and (3) valley land form modifiers. Under Fluvial Patterns, regularity of course and distribution patterns are branched to morphometry. The morphometry can be described by depth and width. Each of the three sub-branches can be divided into five or six sub-classes in Table 1. Their visual characteristics are given in Figures 6 to 8.

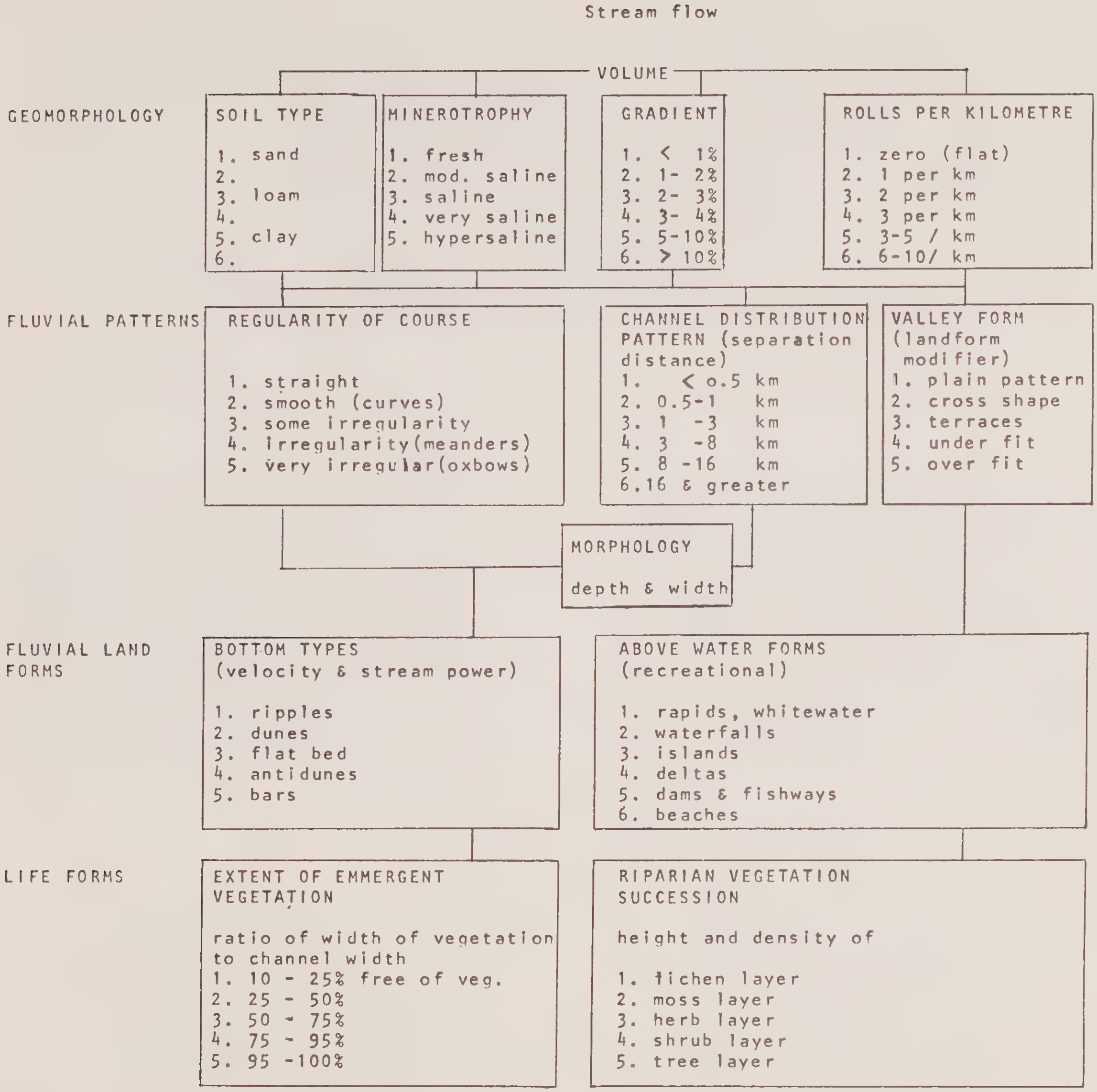

Table 1: Stream Habitat Mapping System for Water Regime Classification

Under FLUVIAL LAND FORMS, Regularity of Course and Distribution Pattern (connected to Morphometry) are connected to the BOTTOM TYPE classification. Land Form Modifiers derive the ABOVE WATER FORMS. Under LIFE FORMS, Bottom Types is described by the EXTENT OF EMMERGENT VEGETATION. The RIPARIAN VEGETATION SUCCESSION connects to ABOVE WATER FORMS in the branch above LIFE FORMS. In both fluvial land forms and life forms, each class can be described by five or six sub-classes. The visual characteristics of the sub-classes are given in Figures 9 to 12.

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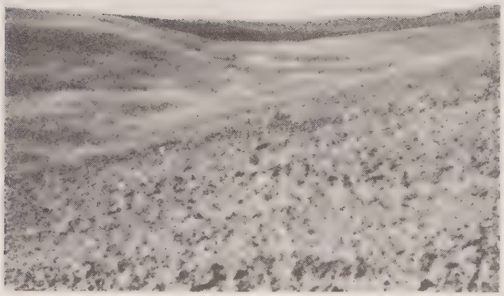

Figure 1: Soil Texture: Till

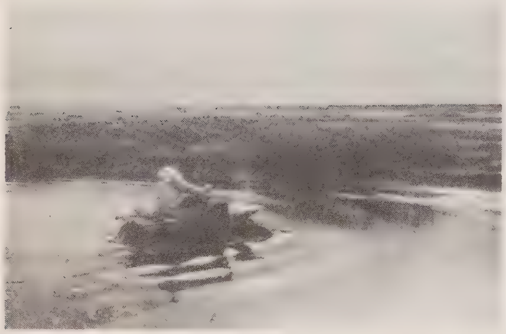

Figure 2a: Minerotrophy: Moderately Saline

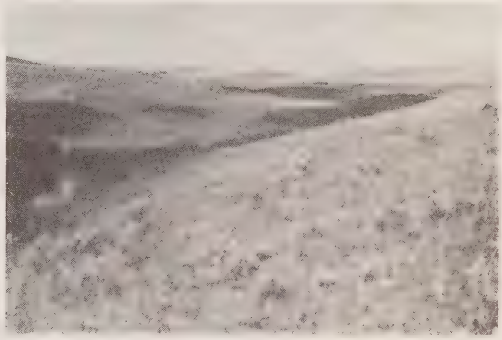

Figure 3a: Gradient: 5-10%

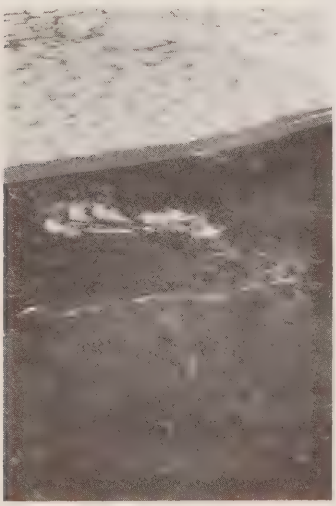

Figure 2b: Minerotrophy: Hypersaline

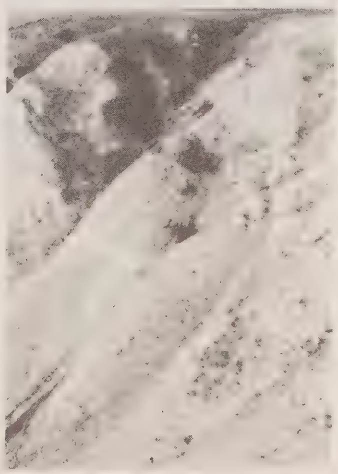

Figure 3b: Gradient: >10%

Figure 4a: 1 Roll per km

Figure 4b: 6-10 Rolls per km

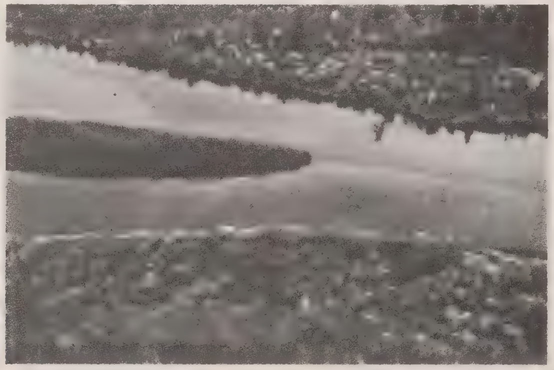

Figure 5: Water Quality: Turbidity

Figure 6a: Regularity of Course: Straight

Figure 6b: Regularity of Course: Smooth

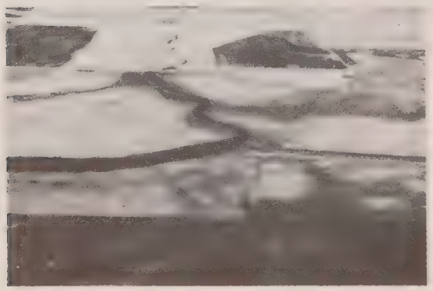

Figure 6c: Regularity of Course: Some Irregularity

Figure 6d: Regularity of Course: Irregular

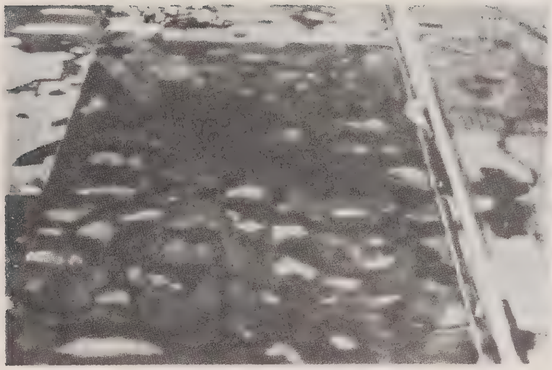

Figure 7a: Channel Distribution: Less than 0.5 km separation

Figure 7b: Channel Distribution: 3-8 km Separation

Figure 8a: Valley Form: Plain

Figure 8b: Valley Form: Cross

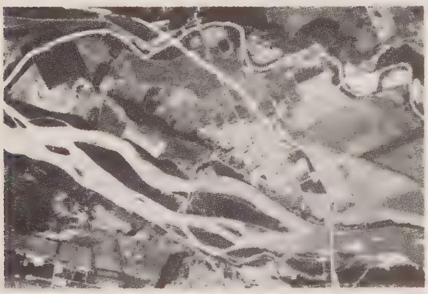

Figure 8c: Valley Form: Terraces

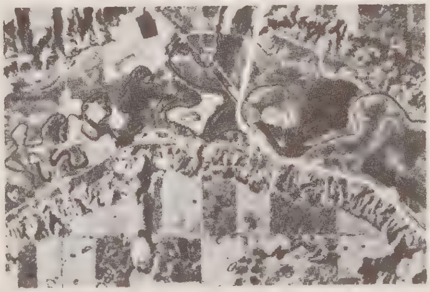

Figure 8d: Valley Form: Underfit

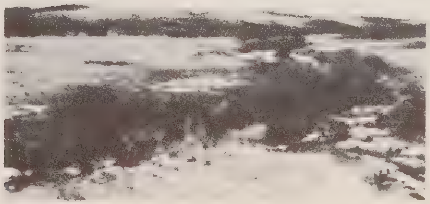

Figure 8e: Valley Form: Overfit

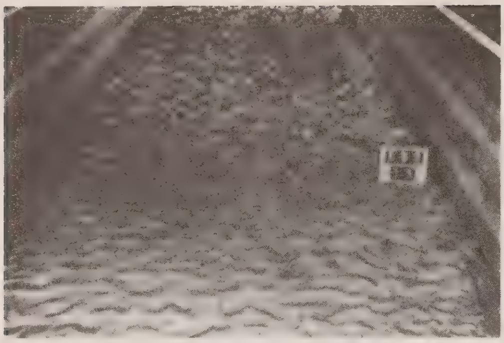

Figure 9a: Bottom Type: Ripple

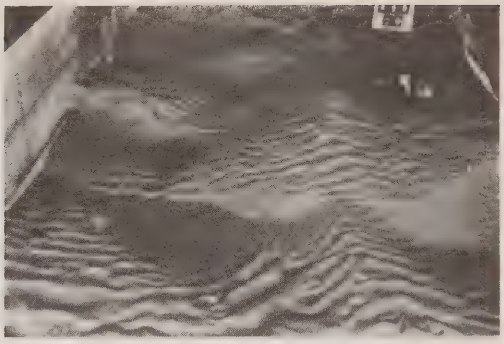

Figure 9b: Bottom Type: Dunes

Figure 9c: Bottom Type: Flat Bed

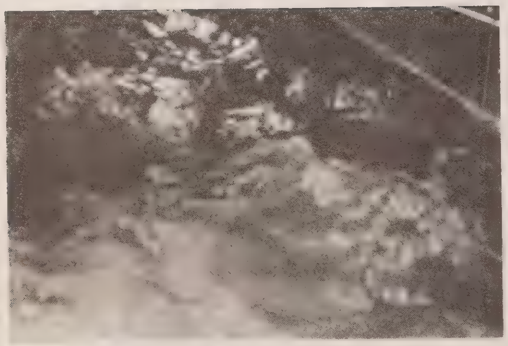

Figure 9d: Bottom Type: Antidunes

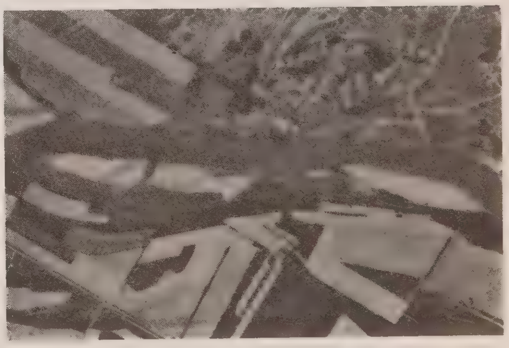

Figure 9e: Bottom Type: Bars

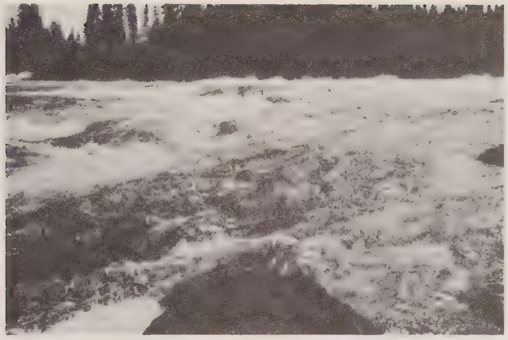

Figure 10a: Above Water Landforms: Rapids

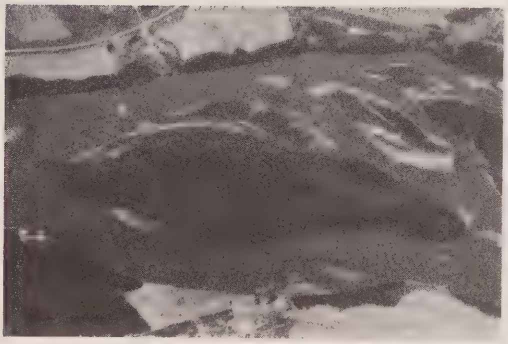

Figure 10b: Above Water Landforms: Islands

Figure 10c: Above Water Landforms: Beaches

Figure 11a: Extent of Emergent Vegetation: 10-25% Free

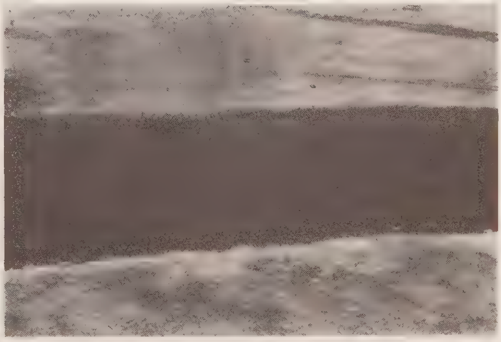

Figure 11b: Extent of Emergent Vegetation: 95-100% Free

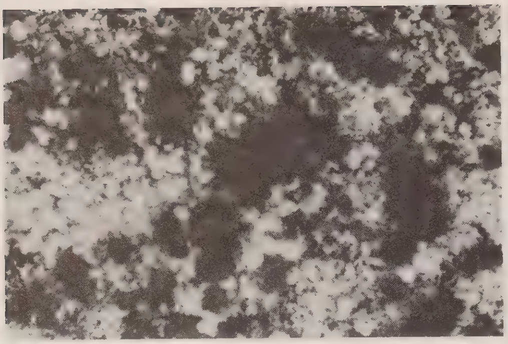

Figure 12a: Riparian Vegetation Succession: Lichen Layer

Figure 12b: Riparian Vegetation Succession: Moss Layer

Figure 12c: Riparian Vegetation Succession: Herb Layer

Figure 12d: Riparian Vegetation Succession: Shrub Layer

Figure 12e Riparian Vegetation Succession: Tree Layer

WETLAND VEGETATION - AN ECOLOGICAL REDISCOVERY *

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Cattails and bulrushes usually conjure up visions of swamps and stagnant, green-water filled ponds with various forms of aquatic low-life that just spoil the view. However, in prairie environments in Canada, the lowly marsh now promises the possibility of being used to produce clean, sparkling water, unpolluted ponds and lakes, sewage treatment for small urban centres, and a food source for cattle.

A Saskatchewan Research Council (SRC) study team, which I have headed for the past four years, has been working on a project that could revolutionize sewage treatment systems in small prairie towns. Earlier work by others suggested that cattails and bulrushes can absorb the toxic substances from domestic and industrial sewage at an incredibly rapid rate. This theory has been tested both in the laboratory and now in the field using a experimental sewage lagoon near Humbodlt, Saskatchewan.

A natural swamp is a completely self-contained system. The cattails and bulrushes absorb the impurities from the water and, at the end of their cycle, they can be harvested. This has been confirmed through extensive experiments using artificial growth chambers at the SRC. At Humboldt, we are using two experimental sewage lagoons planted with about 500 bulrushes and cattails in each. Each lagoon is lined with gravel so that plant roots can more readily absorb nitrogen and phosphorus from the raw sewage which we pump in from the town's storage site to a depth in the lagoon of 45 cm. Each of these one-acre lagoons is large enough to effectively treat the effluent from a town of 500 persons. After two to three weeks, water clean enough for industrial use can be released from the lagoon. Normally, small prairie towns use a series of holding lagoons to treat sewage. Air is pumped in, purifying the water and causing heavier effluent to sink to the bottom, where they remain. In Humboldt's case, the electricity for the air pumping procedure costs about $8,000 per year.

The system we propose could dramatically reduce such costs. Humboldt's bulrush lagoons were opened in August 1979, and phosphorus and nitrogen counts have declined more than 75%. We will be monitoring the ponds at least until 1982.

The harvested bulrushes and cattails offer the potential as a low cost food source for cattle operations. Naturally, this wouldn't be adviseable if the sewage effluents used were to contain highly toxic metals. We have to confirm which undesireable substances may be absorbed by the bulrushes and cattails. However, effluents from most small towns contain few toxic substances of this nature indicating the harvested plants should be safe and quite nutritious for cattle.

The cost of constructing the lagoons has been about $62,000 within a total project cost of $209,000. Sources of the funds were federal and provincial agencies ($152,000), CMHC ($27,000) and Ducks Unlimited ($35,000). The Town of Humboldt donated land for lagoon construction and $4,000 towards the first year's monitoring costs.

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* This note is based on Dr. Lakshman's presentation at the meeting and a brief article which appeared in MacLean's Magazine written by Dale Eisler in October 1979. (ed.)

REPORT ON WETLAND ACTIVITIES ACROSS CANADA

Compiled by
F.C. Pollett
Chairman
National Wetlands Working Group

This report is a summary of presentations by various Working Group members on research, survey and development projects related to wetlands in Canada.

NEWFOUNDLAND AND LABRADOR

With few exceptions, interest in the wetlands of Newfoundland and Labrador has been restricted to peatlands, particularly bog and fen. Indicative of increased interest is the formation in 1978 of the Newfoundland and Labrador Peat Association. This Association was a spin-off effect of a seminar on the Peatland Resources of Newfoundland held in 1977 with delegates from all provinces as well as from the United States and from Europe. The Peat Association publishes a quarterly newsletter titled PEAT NEWS and is also preparing a book on the Diversity of Peat. The book's contents are based on the 1977 seminar with added solicited contributions.

Much of the current research on wetlands is undertaken through the federal research agencies such as the Canadian Forestry Service, Agriculture Canada, and Canadian Wildlife Service. Mr. E.D. Wells, Newfoundland Forest Research Centre of the Canadian Forestry Service, has recently synthesized data on the classification of Newfoundland's peatlands. The peatlands have been grouped into ten main morphological types.

1. Eccentric Raised Bog
2. Concentric Raised Bog
3. Plateau Raised Bog
4. Basin Bog
5. Slope Bog
6. String Bog
7. Blanket Bog
8. Slope Fen
9. Ladder Fen
10. Patterned Fen

In addition, Wells has prepared a peatland region map for the insular portion of Newfoundland and is working on a preliminary classification of peatlands in eastern Labrador. Much of this work will be soon published in a chapter on the "Peatlands of Newfoundland" being prepared for a monograph on the Biogeography and Ecology of the Island of Newfoundland. This will be published by Monographie Biologicae.

Comprehensive classification and inventory of peatland resource is prerequisite to wise land use planning. In 1978, a survey of peatlands in insular Newfoundland was begun. The main objectives of the survey were to determine the location, extent, volume and general characteristics of the province's peatland resources. The first phase of the survey completed in 1978, included mapping of 19,577 organic deposits, covering 135,493 ha and 3,156,579,140 m^3, in northeastern Newfoundland. In addition, the survey assessed composition, surface morphology, and area and patterns of bogs within bogs greater than 30 ha, and fens greater than 5 ha. The size and depth of organic deposits, as well as extent of surface water, drainage limitations and degree of decomposition, are the most important factors in assessing suitability of peatlands for various uses; these factors are being studied in the present inventory. The inventory will be undertaken in western Newfoundland in 1979 and most likely eastern Newfoundland in 1980. The Provincial Department of Forestry is co-ordinating the inventory in co-operation with the Canadian Forestry Service and the Provincial Department of Agriculture. Basis of classification for the inventory is the Zoltai et al paper of 1975.

As a result of the 1978 peat inventory, a quick response was possible in selecting a peat site for the first peat fuel harvesting trial in Newfoundland. This activity will begin this fall and involves university and government agencies as well as private industry. This peat fuel harvesting will be the first trial of its kind to be undertaken in North America under maritime climatic conditions.

There is an upswing in the interest of using peatlands for agriculture and the Province is

currently developing a comprehensive agriculture policy that will include emphasis on peatland utilization. Agriculture Canada and Canadian Forestry Service have ongoing research programs related to use of peatlands for growing agricultural and forestry crops.

Marshes and freshwater habitats are being surveyed in Newfoundland and Labrador by the Canadian Wildlife Service. Habitats are being categorized on the basis of their vegetation. Efforts are underway to try and estimate productivity potentials of particular marsh types.

NOVA SCOTIA

In 1978, the Environmental Control Council of Nova Scotia sought the opinions of the federal Department of the Environment, and other agencies, with respect to the desirability of a formal wetlands policy for the Province of Nova Scotia. Current legislation contains some authority for regulations with respect to wetlands use, but there is no specific legislation or regulation dealing with either coastal, salt marsh or upland wetlands. The Council solicited comments and observations on the importance of specific fresh and salt water wetland systems with respect to environmental and long-term economic values as opposed to short-term economic considerations.

A committee of departmental representatives encompassing Environmental Protection Service, Fisheries and Marine Service, Atmospheric Environmental Service, Canadian Wildlife Service and chaired by the Lands Directorate of Environmental Management Service was formed to respond to this request. This working committee prepared a short brief outlining federal concerns re wetlands and this brief was submitted to the Environmental Council and to the Deputy Minister of the Nova Scotia Department of the Environment for consideration.

This brief is appended to this paper (Appendix 1) not only to indicate federal concerns re wetlands within Nova Scotia, but also to provide a good background to the Committee members here on the wetland resources of Nova Scotia.

Nova Scotia Peatland Inventory

With the beginning of the 1979 fiscal year, the Province of Nova Scotia, through a Mineral Development Subsidiary Agreement with the federal Department of Regional Economic Expansion, embarked on a five-year, $975,000 peatlands inventory program. The Energy Mineral Section of the Nova Scotia Department of Mines is charged with the overall responsibility of this program.

Nova Scotia is known to contain extensive peat deposits that to date have not received a systematic evaluation. It is felt that the peat deposits of the province hold potential for (a) peat fuel, (b) horticultural/industrial uses and (c) as an indicator of economic mineral deposits.

Over the next five years the inventory will consist of:

1. A desk aerial photo compilation of all peatlands in Nova Scotia following initial literature search and familiarization with available pertinent subject matter.

2. Reconnaissance ground checking of peatlands in conjunction with the air photo interpretation and classification of the province's peatlands.

3. Initiation of an extensive field program to determine:

    (a) the areal extent of the peat deposits;

    (b) depth of peat;

    (c) peat type and distribution;

    (d) surface cover classification;

    (e) identification of layer-rock type immediately below the peat;

    (f) analytical procedures to obtain maximum information from samples obtained, i.e., ash content, moisture, pH, nutrient content and trace elements.

It is planned that the information will be presented in similar format to the other inventories currently in progress so that a meaningful exchange of information will be possible. Results will be presented in reports containing maps, cross-sections and recommendations for the utilization of the peat type contained in each deposit.

Wetlands Inventory for Wildlife Management Purposes

The classification and evaluation of the wet-

lands of Nova Scotia for wildlife management purposes is being undertaken by the Wildlife Division of the Nova Scotia Department of Lands and Forests. The method outlined by Francis C. Golet in "Classification and Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast" is being utilized. Under this system wetlands are broken down into classes and sub-classes according to the dominant life form of vegetation present and the depth and permanence of surface water. Other components of the system include size categories, topographic and hydrologic location, surrounding habitat types, proportions and interspersion of cover and water and vegetative interspersion. Through a system of specifications and ranks, wetlands are then rated according to their wildlife value.

The major river basin in Nova Scotia, the Shubenacadie-Stewiacke, has been inventoried. As well, Pictou, Antigonish and Halifax Counties are completed. There is no definite time schedule for the completion of the rest of Nova Scotia.

Mike Malone of the Canadian Wildlife Service has carried out ecosystem mapping at a scale of 1:7200 for the Wallis Bay and Chignecto National Wildlife Areas as well as the Amherst Point Bird Sanctuary.

Salt Marshes

The salt marshes of Nova Scotia played a vital part in the history of Acadia. The marshes actually provided the economic basis of the early farming communities. It was in the marshes that the early European settlers found the pasturage and the rich soil they sought. In pre-settlement days the natural salt marshes of Nova Scotia exceeded 28,000 ha. Over the years, through dyking, this average has dwindled to the point where now there exists approximately 9,700 ha of natural salt marsh.

The Wildlife Division of the Department of Lands and Forests, along with the Canadian Wildlife Service and Ducks Unlimited, have supported or conducted inventories of salt marsh plant communities for wildlife management purposes. Inventories have concentrated on the marshes along the Fundy shore. Andy Palmer of the Lands Directorate is engaged in studies of the Tantramar marshes and how they may be affected by any possible changes in the tidal regime as a result of a barrage across Minas Basin. Preliminary results of recent field studies indicate that minor changes ($<$ 10 cm) in the tidal behaviour are unlikely to affect the distribution of the salt marsh communities or proper drainage of the freshwater impoundments.

Appendix I

Response from Environment Canada to the Environmental Control Council Regarding a Nova Scotia Wetlands Policy

This is a response to a request for comments from Environment Canada concerning the possible development of a Nova Scotia wetlands policy. Such a policy would have definite implications for the responsibilities, programs and activities of this Department. This preliminary response outlines, in a general way, the environmental significance of wetlands and some of the federal legislation which applied to these important areas.

Both tidal marshes and upland wetlands are vital to the stability and productivity of the natural environment. It is well documented that wetlands serve as habitat, shelter and sources of food for a wide variety of fish and wildlife species. Many upland wetlands act as water storage areas for flood control and may serve to balance the flow of streams during dry summer months. In addition, wetlands, with their vast diversity of plant and animal life, are ideal areas for outdoor educational and recreational purposes.

Coupled with these intrinsic values of wetlands is the fact that tidal marshes, in particular, are among the most productive of natural ecosystems and approximately half of their organic production is removed by tides and animal activity. Adjacent marine and estuarine communities benefit greatly from this nutrient supply. Near urban and industrial centres wetlands can be important as areas of purification by recycling nutrients from sewage and by providing ample detritus for the abundant bacteria; thus amplifying the conversion of urban and industrial waste into marine resources.

Wetlands within Nova Scotia have a particular significance to wildlife. Tidal marshes serve an important role as stopover areas for waterfowl migrating along the Atlantic Flyway. In addition, these marshes support adult populations of several commercially important species of fish and shellfish and serve as a nursery for larval or juvenile populations of many other species.

Environment Canada fully recognizes the importance and value of preserving wetlands. Currently, there are approximately 9,600 ha. of salt marsh along Nova Scotia's shoreline, roughly one-third the amount of marsh of pre-settlement days. These figures accentuate the need for a full assessment of land practices affecting these wetlands. Several federal acts allow officials some degree of regulation of wetlands with regard to the well-being of animal species and fisheries utilizing these areas. These Acts include the Fisheries Act, Migratory Birds Convention Act, Canada Wildlife Act and to some degree the Canada Water Act and Ocean Dumping Control Act.

The recently amended Fisheries Act provides for protection of fish habitat (migration, nursery, rearing and feeding) which includes wetlands and also restricts the introduction of deleterious substances into waters frequented by fish. The Migratory Birds Convention Act protects the welfare of all migratory bird species. Thus, protection of habitat, a large portion of which included wetlands, is implied. Under the mandate of the Canada Wildlife Act the Canadian Wildlife Service is acquiring parcels of land across the country as National Wildlife Areas. Five such areas have been established in Nova Scotia protecting 2,200 ha of habitat, much of it marshland. The Ocean Dumping Control Act prohibits deposition of waste materials within the tidal lands. Federal/provincial advisory committees under the Canada Water Act can include the study of wetlands as part of the overall agreement in the development of comprehensive plans for the management of water resources.

The Department recognizes the need for co-ordinated federal and provincial legislation covering wetlands and firmly supports the development of a wetlands policy for the Province. One of the most pressing requirements is the need to develop an information system that would illustrate to the general public the value of natural wetlands for the ecological well-being of the Province of Nova Scotia.

Wetlands cannot be considered in isolation. Activities on adjacent lands can be very deleterious to the wetlands themselves. Thus, the question of buffer zones arises. Similarly, there are many dyked marginal agriculture lands that may be better utilized if returned to marshland; this involves the question of conflicting land uses. Such considerations are only examples of the kinds of problems that cannot be solved by the development of a policy or legislation with a single focus. An intergovernmental consultative committee on wetlands is suggested as one way to ensure that all environmental implications are taken into account when considering the future disposition of wetlands in the Province.

The regional elements of the Department of the Environment would support a joint federal/provincial approach to the development of policy, strategy or compatible legislation for the protection of the Province's wetlands. Indeed, such cooperative approaches to the long-term management of many of the nation's coastal resources will be discussed at senior political and bureaucratic levels at the Canadian Council of Resource and Environment Ministers (CCREM) Shore Management Symposium scheduled to be held in October 1980. The development of a wetlands policy could certainly benefit from the cooperative measures which can be expected to arise from this Symposium. In any event, senior level consultation between the Departments concerned would be most beneficial towards achieving mutually supportive developments in this regard.

PRINCE EDWARD ISLAND

Prince Edward Island, through a joint federal/provincial project of the Atlantic Provinces Soil Institute in Charlottetown, is currently being mapped as to the Island's organic soils and landforms. Mr. C. Veer of Agriculture Canada has produced a preliminary report on the "Organic Soils of Prince Edward Island (1978)". With seven years' field work completed, compilation of one hundred detailed maps at a scale of 1:10,000 is now underway and is expected to end in 1980.

On his report Mr. Veer has categorized his wetlands under the following descriptive names:

Plateau Bog	Brook Swamp
Flat Bog	Vale Swamp
Bowl Bog	Telluric Swamp
Channel Fen	Cedar Swamp
Black Spruce Fen	Marsh Swamp

Some of these peatland categories differ from those offered by Charles Tarnocai for the proposed Wetlands Registry. However, a close analysis of the detailed definitions of Mr. Veer's classification and that presented for general comment to this Committee reveals that discrepancies are more semantics than ideology.

No agricultural or horticultural use is made of the organic soils for crop production on Prince Edward Island. A minor commercial horticultural peat operation exists on the Island. Mining for fuel peat does not take place.

The Fish and Wildlife Division is currently conducting an inventory of Prince Edward Island's wetlands. This inventory is tailored, in large part, after the similar program being carried out in Nova Scotia.

NEW BRUNSWICK

The member from New Brunswick was not present. One item of note relative to New Brunswick is the expansion of the peat horticultural industry in that province as well as interests in use of the resource for fuel and of certain sites for agriculture. In response to the demands for multi-use of peatlands, the Department of Natural Resources initiated a detailed inventory of the provicial resource. This inventory is on-going and to date 42% of the peatlands have been surveyed. An additional area of 15 000 ha are to be surveyed in this year.

QUEBEC

Estaban Chornet gave a short presentation in the absence of the Working Group member from Quebec.

At present the horticultural and agricultural uses of peatlands are most demanding. Peat fuel has also created recent focus. The provincial government is undertaking an inventory of peatlands in the Lower St. Lawrence Region in the area of intensive peat moss harvesting. Samples from this survey are being analyzed at Laval (horticultural properties) and Sherbrooke (fuel peats).

A series of studies on peat fuel has been initiated by Quebec Hydro through the Institute of Research and Electricity of Quebec. The objective is to investigate the possibilities of supplying power to the Northern St. Lawrence Region. It was thought that a demonstration plant for using peat to produce gas for a diesel engine might be established on Anticosti Island.

Feasibility studies have been carried out by Quebec Hydro in the Sagenquay Region concerning the establishment of a 300 mw plant. Recent activities on classification and related research were not reported.

ONTARIO

The Federal Lands Directorate project, described by Daryl Cowell et al in the Proceedings of the Second Meeting of the Canada Committee on Ecological Land Classification, is continuing. This work will be undertaken on sections of the Hudson Bay coast which are of particular interest to the Canadian Wildlife Service since these serve as major nesting and staging areas for migratory wildlife.

Walter Glooschenko of the National Water Research Institute is continuing his work on the coastal marshes of the Ontario portion of the Hudson Bay Lowlands. (This is elaborated on in Dr. Glooschenko's paper). The coastal marshes classification requires elaboration in the Wetlands Classification for Canada (one class for coastal marsh vs. thirteen classes for bogs and eleven classes for fens). It is important that the Wetlands Working Group colaborate with Dr. Glooschenko and others to achieve this elaboration of the national wetlands classification.

At the University of Guelph, Professor Protz is continuing his studies of the classification and genesis of soil types in the Hudson Bay Lowlands and Professor Martini is continuing studies of sedimentation processes in the same area. The elucidation of soil development and sedimentation processes are essential to our specification of the 'descriptive adjuncts' of the classes in a Canadian Wetland Classification.

At the Royal Ontario Museum, John Riley is continuing his work of adding specimens to the Museum's reference collection of Hudson Bay Lowlands vegetation. In addition he will continue to provide the vegetation investigations for the field work of the Ontario Centre for Remote Sensing Wetlands Project.

The OCRS Wetlands Project, which was outlined by Simsek Pala and Boissoneau in the Proceedings of the Second Meeting of the CCELC, has reached a stage where field work for about 60% of the Ontario portion of the Hudson Bay Lowlands has been completed. The relict beaches throughout the Lowlands, since they are not all clearly delineated on LANDSAT imagery, have been delineated using 1:60,000-scale

NAPL photos. During the 1979-80 office season, the mapping of this portion of the Northwestern Ontario Lowlands will be completed. This will be accomplished by extrapolating our field data using the NORPAK RGP 3050 System and a PDP 11/34 Computer to analyze LANDSAT tapes using ARIES software which was developed for the Forest Management Institute. This software comprises both classification and enhancement capabilities. Plans have been made and preliminary work has been completed for the 1979 field season when the field work for the uncompleted portions of the Ontario part of the Hudson Bay Lowlands will be undertaken.

"The Canadian Field Naturalist" continues reviews of wetland publications and Boissoneau recently had the opportunity to publish a review on some Canadian concepts of wetlands classification. The Federation of Ontario Naturalists, at their annual meeting this May, heard Steve Curtis of the Canadian Wildlife Service outline the activities of that agency in acquiring wetlands in Southern Ontario which have a high capability of waterfowl use. The Federation of Ontario Naturalists also have a special issue of the "Ontario Naturalist" in press which is devoted to Ontario wetlands. In addition to the wetlands of Lake Ontario which were visited for field meetings of the Federation of Ontario Naturalists, led by Mrs. Glooschenko and members of the Durham Region Naturalists Club, the wetlands of the Bruce Peninsula have been the focus of Federation of Ontario Naturalists field meetings.

The Wildlife Branch of the Ontario Ministry of Natural Resources surveyed North American wetland classification systems and evaluated the relative merits of each when applied to future wetland projects of the Branch. This study recommended the use of the wetlands classification framework of Zoltai et al, 1975.

Ducks Unlimited has regional offices in London, Aurora, Kingston, with a total staff of ten. An inventory of wetlands is planned in Southern Ontario.

MANITOBA

At present the Manitoba Soil Survey is continuing the mapping of organic soils in Southern Manitoba. The Department of Renewable Resources is involved in documenting deep sphagnum deposits that could be used in the horticultural industry.

Delta Marsh is the focal point for wetland research. A management plan for Delta Marsh has been developed by a technical advisory committee comprised of provincial and federal officials. On a smaller scale, the Delta Waterfowl Research Station has put in place a 20-year project in co-operation with "Ducks Unlimited" to develop eleven artificial ponds for research. Ponds will be maintained at different water levels for different periods of time and a variety of research tables will be completed. This year is the first of the 20-year period.

In Manitoba, Ducks Unlimited is undertaking an inventory of all wetlands greater than 40 ha in area. This is being undertaken throughout the southern half of Manitoba and should be completed within five years. Millar's classification is used in classification of wetland types. Mapping is at a 1:50,000 scale.

SASKATCHEWAN

This report is restricted to the southern portion of the province where agricultural-wildlife conflicts are most in the forefront. Wetlands are difficult to manage for wildlife because they are virtually all privately owned. Some are being destroyed through drainage and burning. The Saskatchewan Department of Tourism and Renewable Resources, through the Habitat Protection and Development Division, have a program for acquisition of terrestrial habitat. They now have 20 000 ha, some of which is wetland. This division is also monitoring agricultural developments related to wildlife. The Wildlife Research Division has an on-going biophysical and land tenure mapping program.

Within the Canadian Wildlife Service there is a modest wetland acquisition program. Millar is responsible for studying trends in habitat conditions.

Ducks Unlimited's inventory of the wetlands mentioned for Manitoba is also underway throughout Saskatchewan and Alberta.

The Saskatchewan Wetlands Working Group is a forum of 14 members representing various disciplines such as forestry, wildlife, hydrology, agriculture, fisheries and soil science. Discussion centres around the need for a working classification for prairie wetlands. This may be Millar's classification or indeed a new classification based on future experience through use of the Wet-

land Registry. The group is interested in trying to meet the problems of agriculture-wildlife conflict. There is also a desire to develop a stream classification and to standardize wetland water terminology.

Another group actively involved in wetland research is the Engineering Division of the Saskatchewan Research Council. These activities have been elaborated in papers by J. Whiting and G. Lakshman in these proceedings.

ALBERTA

The only new activity in wetlands involves an interest of the Provincial Forest Service to use peatlands in a drainage program for increasing forest yields. Members of the National Working Group will be advising the provincial authorities on the development of this program. A number of biophysical surveys and impact assessments have been undertaken by consultants. Many of these reports involve data on wetlands. One other source of information is the University of Alberta where studies on the vegetation of Alberta's wetlands are continuing.

BRITISH COLUMBIA

A B.C. Wetlands Working Group has been established by the Vegetation Functional Subcommittee of the B.C. Land Resources Steering Committee. The B.C.W.W.G. consists of about five members, with representation from vegetation, soil and hydrology sectors. Access to expertise in other disciplines, primarily wildlife, range management and agriculture, is usually available. The primary objetives of the working group are to develop and implement a wetland classification system for B.C. that is functional and applicable to a wide variety of potential users and to coordinate wetland inventorying.

A major meeting was held in January 1978 at which about 80 persons, representing nearly all government agencies, industry and private interest groups that had association with wetlands, were brought together. There were several objectives for the meeting, the most important being to determine what agencies or people were actively engaged in wetland related work; what problems were being encountered; what user requirements for a classification system might be, and where we stood with reference to developing a classification system. One of the initial problems was in selecting a suitable definition for wetlands. A consensus was eventually attained on the following definition:

> *Wetlands are areas that are wet enough or innundated frequently enough to develop and support a distinct natural vegetation that is in strong contrast to adjacent better-drained areas or open water.*

One significant outcome of the meeting was the establishment of five ad hoc regional subgroups plus one subgroup for verifying wetland region boundaries. The regional subgroups consisted of 8-14 members and were given the objectives to identify (1) specific user requirements, (2) kinds of users, nature of problems and conflicts currently being experienced, (3) level of precision required for mapping, data gathering, etc., (4) requirements of the classification scheme imposed by user demands, and (5) to priorize work in specific areas. This information was to be obtained and a report prepared within one year, at which time the subgroups would dissolve.

In April 1979, a follow-up meeting of the B.C.W.W.G. plus the Chairman of the subgroups was held to evaluate progress and to plan further activities. The effectiveness of the subgroups varied from very good to essentially nil. One factor that caused problems was the lack of a clear-cut mandate so that subgroup members could function properly, especially in parts of B.C. where wetland activities receive a very low priority. A recommendation has been submitted to the B.C. Land Resources Steering Committee to assist in rectifying the situation.

It was necessary to re-structure the B.C.W.W.G. to fill vacancies arising from staffing alterations of several government agencies. The new group consists of Tom Chamberland (Hydrologist), Herb Luttmerding (Soils) and Jim van Barneveld (Vegetation) of the B.C. Ministry of the Environment, Al van Ryswyk (Range Management) of Agriculture Canada, and Ed Oswald (Chairman) of the Canadian Forestry Service.

The regional subgroups were also reinstated, but reduced to four, and the objectives were altered. These now consist of, along with the chairmen, (1) Boreal-Peace, Howard Slavinski, Agriculture Canada, (2) Boreal-

Cariboo, Marty Beets, B.C. Ministry of Recreation and Conservation, (3) Coast Mountains, Jim Pojar, B.C. Ministry of Forests, and (4) Coast Marine, Bruce Pendergast, B.C. Ministry of Recreation and Conservation. The objectives were redefined as follows: (a) to determine the requirements of a classification system based on the user specifications of the area, (b) to evaluate existing systems, or parts of them, for meeting the requirements, and (c) to identify problem situations or areas that require special attention. It was also requested that the regional subgroup chairman attend and participate in B.C.W.W.G. meetings.

The primary objective remains to develop and implement a B.C. wetland classification system that is compatible to the national system but is functional for satisfying user requirements and can be implemented by a variety of field personnel. The intention is to review and test existing classification systems to see how they, or parts of them, meet the requirements. The system components, or modifications of them, will be amalgamated periodically into a consolidated approximation to a B.C. Wetland Classification System. The first endeavor toward this end is anticipated at a meeting scheduled for this autumn.

Currently, major areas of concern occur in the Cariboo-Chilcotin where there is a pronounced interface between wetlands and drier meadows, and in the coastal environments where few existing classification systems apply. The meadows of the Cariboo-Chilcotin area are under pressure for grazing, agriculture and wildlife and a classification system that will separate them for optimal utilization is required. These meadows often occur at the borderline between wetland and non-wetland, and are not adequately treated by current systems. Classification problems occur where these areas are inundated with water only part of the year and the degree of inundation may vary from year to year. They are placed under the marsh category, but lower level divisions are being defined that may not fit the criteria of a marsh; consequently, there is a tendency to equate a meadow at the same level as a marsh.

In the coastal environments, several problems occur, among which are wetlands occurring on sloping, rocky terrain. These may appear as bogs or fens, but lack the depth of organic matter required for those categories. The intimacy with which they occur on the landscape and the lack of clear-cut criteria result in designations such as bog-fen. These occur on colluvial or till slopes that receive high precipitation (about 2000 mm or more), and also have a lot of runoff water passing over them. The vegetation varies from area to area, but trees, shrubs, herbs, grasses and moss are usually present in variable proportions.

Consideration is being given to formulating a wetland type registry to include a full description of a wetland that is near the modal criteria for each category in the classification system. This is not meant to be a duplication of the national wetland registry, but rather as a reference tool for persons engaged in wetland classification and inventory within the province. Most field personnel have adopted the soil and vegetation data forms prepared by the Resource Analysis Branch of the B.C. Ministry of the Environment for putting field data into computer files. Most of the required data for the wetland descriptions are recorded on these forms, with the possible exception of some hydrological parameters. The information obtained from these forms will undoubtedly form the basis of the initial registry, as opposed to constructing a new form and data analysis system. The capability is presumably available to obtain printouts of the two forms together and such reproductions will be made available on request. The final version will probably consist of a complete description of the wetland type, the amount of allowable variation in each parameters, schematic diagrams and aerial and ground photographs. This could then be appended to the classification system.

RAPPORT SUR LES ACTIVITÉS TOUCHANT AUX TERRES HUMIDES DANS L'ENSEMBLE DU CANADA

Compilé par
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Le présent rapport est un sommaire des présentations faites par divers membres de groupe de travail sur des projets de recherche, d'enquêtes et d'aménagement portant sur les terres humides du Canada.

TERRE-NEUVE ET LE LABRADOR

À quelques exceptions près, l'intérêt manifesté pour les terres humides de Terre-Neuve et du Labrador s'est limité aux terrains tourbeux, en particulier les tourbières oligo- et minerotrophes. La création en 1978 de la Newfoundland and Labrador Peat Association témoigne de l'intérêt accru pour ce domaine. La création de cette association constitue une retombée d'un séminaire qui s'est tenu en 1977 sur les ressources des milieux tourbeux de Terre-Neuve et auquel ont participé des délégués de toutes les provinces ainsi que des États-Unis et de l'Europe. La Peat Association publie un bulletin trimestriel intitulé Peat News et prépare également un ouvrage sur les diverses catégories de tourbières. La matière du livre est basée sur les travaux du séminaire de 1977 auxquels s'ajoutent des contributions sollicitées.

Une bonne part des recherches actuelles sur les terres humides est menée par des organismes de recherche fédéraux tels que le Service canadien des forêts, Agriculture Canada et le Service canadien de la faune. M. E.D.Wells, du Centre de recherches forestières de Terre-Neuve, Service canadien des forêts, a récemment réuni des données sur la classification des tourbières de Terre-Neuve. Ces tourbières ont été regroupées en dix grands types morphologiques.

1. Tourbière bombée excentrique
2. Tourbière bombée concentrique
3. Tourbière bombée de plateau
4. Tourbière de bassin
5. Tourbière inclinée
6. Tourbière à côtes
7. Tourbière en couverture
8. Tourbière minerotrophe inclinée
9. Tourbière minerotrophe en échelle
10. Tourbière minerotrophe reticulée

En outre, Wells a préparé une carte régionale des terrains tourbeux pour l'île de Terre-Neuve et il travaille présentement à une classification préliminaire des tourbières de l'est du Labrador. Une bonne partie de cet ouvrage sera la matière d'un chapitre sur les tourbières de Terre-Neuve, qui est en cours de rédaction et qui fera partie d'une monographie consacrée à la biogéographie et à l'écologie de l'Île de Terre-Neuve. Ce dernier ouvrage sera publié dans la série Monographie Biologicae.

La classification et l'inventaire exhaustifs de la ressource des tourbières sont préalables à une planification judicieuse de l'utilisation des terres. En 1978, on a entrepris un relevé des tourbières de l'île de Terre-Neuve, qui avait pour principaux objectifs de déterminer la position, l'étendue, le volume et les caractéristiques générales des tourbières de la province. Achevée en 1978, la première phase du relevé comprenait la cartographie de 19,577 dépôts organiques dans le nord-est de Terre-Neuve recouvrant 135,493 ha et 3,156,579,140 m^3. Le relevé à également permis d'analyser la composition, la morphologie de surface, ainsi que la superficie et la configuration des tourbières oligotrophes de plus de 30 ha et des tourbières minerotrophes de plus de 5 ha. La quantité et la profondeur des dépôts organiques ainsi que l'étendue des eaux de surface, les limites du drainage et le degré de décomposition sont les facteurs les plus importants qui déterminent les diverses possibilités d'utilisation des tourbières; ces facteurs seront examinés dans le cours de cet inventaire, qui sera amorcé dans l'ouest de Terre-Neuve en 1979 et fort probablement dans l'est de Terre-Neuve en 1980. Le ministère provincial des forêts s'emploie présentement à coordonner l'inventaire de concert avec le Service canadien des forêts et le ministère provincial de l'Agriculture. La classification préliminaire est fondée sur l'étude de Zoltai et al (1975).

L'inventaire des tourbières en 1978 a rendu possible le choix du premier terrain expérimental de récolte de la tourbe

combustible à Terre-Neuve. Ces activités commenceront cet automne avec la participation d'organismes universitaires et gouvernementaux ainsi que de l'industrie privée. Il s'agira de la première expérience du genre à être tentée en Amérique du Nord dans des conditions de climat maritime.

On assiste présentement à un regain d'intérêt pour l'utilisation des terrains tourbeux à des fins agricoles et Terre-Neuve élabore présentement une politique agricole d'ensemble qui accordera une importance particulière à l'utilisation des tourbières. Pour leur part, Agriculture Canada et le Service canadien des forêts poursuivent des programmes de recherche liés à l'utilisation des terrains tourbeux pour la pratique de cultures agricoles et forestières.

Le Service canadien de la faune poursuit présentement une étude des marais et des habitats d'eau douce de Terre-Neuve et du Labrador. Les habitats sont classés selon le type de végétation qu'on y trouve. Des efforts sont mis en oeuvre pour évaluer le potentiel de rendement de certains types de marais particuliers.

NOUVELLE-ÉCOSSE

En 1978, l'Environmental Control Council de la Nouvelle-Écosse a demandé l'avis du ministère fédéral de l'Environnement ainsi que d'autres organismes quant à l'opportunité d'adopter une politique officielle des terres humides pour la Nouvelle-Écosse. Les lois en vigueur donnent le pouvoir de légiférer sur l'utilisation des terres humides, mais aucune loi ni règlement ne traite spécifiquement des terres humides côtières, terres humides hautes ou des marais salants. Les commentaires et les observations sollicités par le conseil avaient trait à l'importance de systèmes particuliers de terres humides d'eau douce et d'eau salée du point de vue de l'environnement et de la rentabilité économique à long terme en regard de considérations économiques à court terme.

Un comité présidé par la Direction régionale des terres du Service de la gestion de l'environnement et composé de représentants du Service de la protection de l'environnement, du Service des pêches et de la mer, du Service de l'environnement atmosphérique et du Service canadien de la faune a été mis sur pied pour répondre à cette demande. Ce comité d'étude a rédigé un bref exposé des préoccupations du gouvernement fédéral au sujet des terres humides et le document a été soumis à l'examen du Environmental Control Council et du Sous-ministre de l'Environnement de la Nouvelle-Écosse.

Cet exposé figure en annexe 1 de la présent étude non seulement pour indiquer les préoccupations du gouvernement fédéral à l'égard des terres humides de la Nouvelle-Écosse, mais également pour fournir aux membres du comité une bonne documentation de base sur la ressource palustre de la Nouvelle-Écosse.

Inventaire des tourbières de Nouvelle-Écosse

Au début de l'année financière 1979, la province de Nouvelle-Écosse a entrepris un programme quinquennal d'inventaire des tourbières estimé à $975,000 par la signature d'un accord complémentaire d'exploitation minière avec le ministère fédéral de l'Expansion économique régionale. La Section de l'énergie minière du ministère des Mines de la Nouvelle-Écosse a la responsabilité globale de ce programme.

Il est reconnu que la Nouvelle-Écosse recèle des vastes dépôts de tourbe qui n'ont pas encore fait l'objet d'une évaluation systématique. On estime que ces dépôts offrent des possibilités a) comme combustible, b) d'usage horticole et industriel, et c) comme indice de dépôts minéraux ayant une valeur économique.

Au cours des cinq prochaines années, l'inventaire consistera:

1. En l'assemblage de prises de vues aériennes de toutes les tourbières de la Nouvelle-Écosse, après une recherche documentaire préliminaire et une familiarisation avec les ouvrages pertinents accessibles.

2. En une vérification de reconnaissance au sol des tourbières effectuée en même temps que l'interprétation des photos aériennes et la classification des tourbières de la province.

3. En la mise sur pied d'un vaste programme sur le terrain, en vue de déterminer:

   a) l'étendue des dépôts de tourbes en ha;

   b) la profondeur de la tourbe;

   c) le type et la répartition des tourbières;

   d) la classification de la végétation de surface;

e) la nature des couches de roche situées immédiatement au-dessous de la tourbe;

f) les méthodes d'analyse permettant d'obtenir le maximum d'information des échantillons prélevés, par exemple le contenu de cendres, l'humidité, l'acidité, le contenu d'éléments nutritifs et d'éléments à l'état de traces.

On projette d'adopter la même formule de présentation de l'information que dans les autres inventaires en cours en vue de rendre possible un échange fécond d'information. Les résultats seront présentés dans des rapports contenant des cartes, des coupes transversales et des recommandations pour l'utilisation du type de tourbe propre à chaque dépôt.

Inventaire des terres humides à des fins de gestion de la faune

La classification et l'évaluation des terres humides de Nouvelle-Écosse à des fins de gestion de la faune a été entreprise par la Division de la faune du ministère des Terres et Forêts de la Nouvelle-Écosse. On a recours pour cela à la méthode décrite par Francis C. Golet dans un ouvrage intitulé Classification and Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast. Le système consiste en une division des terres humides en classes et en sous-classes selon les types de végétation dominants ainsi que la profondeur et la permanence des eaux de surface. D'autres éléments du système sont les catégories de dimension, la position topographique et hydrologique, les types d'habitats environnants, le mélange et les proportions respectives de végétation et d'eau et le mélange d'espèces végétales. Grâce à un système de description et de classement, les terres humides sont ensuite cotées en fonction de la valeur de leur faune.

Le principal bassin fluvial de la Nouvelle-Écosse, le Shubenacadie-Stewiacke, a fait l'objet d'un inventaire. Les inventaires des comtés de Pictou, d'Antigonish et de Halifax ont également été effectués. Aucun calendrier n'a encore été établi pour l'inventaire du reste de la Nouvelle-Écosse.

Mike Malone, du Service canadien de la faune, a cartographié à l'échelle de 1:7200 les écosystèmes des réserves nationales de la faune de Wallis Bay et de Chignecto, ainsi que la réserve ornithologique d'Amherst Point.

Marais salants

Les marais salants de la Nouvelle-Écosse ont joué un rôle capital dans l'histoire de l'Acadie. De fait, ces marais ont constitué la base économique des premières collectivités agricoles. Ce sont les marais qui ont procuré aux premiers colons européens les pâturages et le sol fertile qu'ils recherchaient. Avant l'époque de la colonisation, la superficie des marais salants naturels de la Nouvelle-Écosse dépassait 28,000 ha. Au fil des années, l'érection de digues a eu pour effet de réduire cette étendue au niveau actuel de 9,700 ha.

La Division de la faune du ministère des Terres et Forêts, de concert avec le Service canadien de la faune et Canards Illimités a appuyé ou effectué des inventaires des communautés végétales des marais salants à des fins de gestion de la faune. La plupart des marais inventoriés étaient situés sur les bords de la baie de Fundy. Andy Palmer, de la Direction régionale des terres, poursuit des études consacrées aux marais de Tantramar, dans lesquelles il cherche à évaluer les incidences que pourrait avoir sur ces marais tout changement dans le régime des marées susceptible d'être occasionné par la présence d'un barrage traversant le bassin de Minas. Les résultats préliminaires d'études récemment effectuées sur le terrain indiquent qu'il est peu probable que les changements mineurs (<10 cm) dans le comportement des marées affectent la répartition des communautés des marais salants ou le bon drainage des réservoirs d'eau douce.

Annexe 1

Réponse d'Environnement Canada à l'Environmental Control Council au sujet d'une politique de la Nouvelle-Écosse relative aux terres humides

Les paragraphes qui suivent répondent à une demande de commentaires d'Environnement Canada au sujet de l'élaboration possible d'une politique des terres humides par le gouvernement de la Nouvelle-Écosse. Une telle politique aurait des répercussions certaines sur les responsabilités, les programmes et les activités du Ministère. Cette réponse préliminaire donne un aperçu général de l'importance écologique des terres humides ainsi que d'un certain nombre des lois fédérales qui s'appliquent à ces secteurs importants.

Les marais côtiers aussi bien que les terres humides des hauts plateaux sont indispensables à la stabilité et à la productivité du milieu

naturel. Des nombreuses études ont démontré que les terres humides servent d'habitat, de refuge et de source de nourriture à un grand nombre d'espèces de poissons et d'animaux sauvages. Un bon nombre de terres humides de l'intérieur jouent le rôle de vastes réservoirs d'eau servant à la régularisation des crues et peuvent aussi servir, durant les mois les plus chauds de l'été, à régulariser le débit des cours d'eau. En outre, la grande variété d'espèces végétales et animales qui l'habitent fait des terres humides une zone idéale pour la pratique des activités éducatives et récréatives en plein air.

À ces avantages inhérents aux terres humides s'ajoute le fait que les marais côtiers en particulier, comptent parmi les écosystèmes naturels les plus productifs et qu'environ la moitié de leur production organique est enlevée par les marées et par l'activité animale. Les communautés adjacentes aux milieux marins et estuariens tirent grand profit de ces réserves alimentaires. Dans le voisinage des centres urbains et industriels, les terres humides peuvent jouer un important rôle de purification en recyclant les matières nutritives des eaux d'égout et en assurant une ample provision de déchets à l'abondante faune bactérienne, permettant ainsi d'accroître la transformation des déchets industriels et urbains en ressources marines.

Les terres humides de la Nouvelle-Écosse sont particulièrement importantes pour la faune. Les marais côtiers jouent un rôle fondamental comme lieux de repos pour les oiseaux aquatiques qui migrent le long de la route de l'Atlantique. En outre, ces marais abritent les populations adultes de diverses espèces commerciales importantes de poissons et de crustacés et servent de milieu nourricier aux larves et aux populations juvéniles de nombreuses autres espèces.

Environnement Canada est parfaitement conscient de l'importance et de la valeur que représente la préservation des terres humides. À l'heure actuelle, la zone côtière de la Nouvelle-Écosse renferme quelque 9600 ha de marais salants, soit à peu près le tiers de la superficie totale de cette catégorie avant la colonisation. Ces chiffres soulignent la nécessité de procéder à une évaluation complète des pratiques d'aménagement qui touchent aux terres humides. Un certain nombre de lois fédérales autorise les pouvoirs publics à adopter certains règlements visant à assurer le bien-être des espèces animales qui fréquentent les terres humides et à protéger les pêcheries qui s'y pratiquent. Ces lois sont la Loi sur les pêcheries, la Loi sur la convention concernant les oiseaux migrateurs, la Loi sur la faune du Canada et, dans une moindre mesure, la Loi sur les ressources en eau du Canada et la Loi sur l'immersion de déchets en mer.

La version récemment modifiée de la Loi sur les pêcheries règle la protection de l'habitat du poisson (migration, milieu nourricier, élevage et alimentation) qui comprend les terres humides, et restreint le déversement de substances toxiques dans les eaux fréquentées par le poisson. La Loi sur la Convention concernant les oiseaux migrateurs vise à protéger le bien-être de toutes les espèces d'oiseaux migrateurs et, par voie de conséquence, l'habitat de ces oiseaux, une grande partie duquel est constitué de terres humides. En vertu des pouvoirs conférés par la Loi sur la faune du Canada, le Service canadien de la faune fait l'acquisition d'étendues de terrain dans l'ensemble du pays, en vue de les convertir en réserves nationales de la faune. Cinq de ces réserves s'étendant sur 2200 ha d'habitat, dont une grande partie est constituée de terres humides, ont été créées en Nouvelle-Écosse. La Loi sur l'immersion de déchets en mer interdit de rejeter des déchets dans les zones côtières. Les comités consultatifs fédéraux-provinciaux créés par la Loi sur les ressources en eau du Canada peuvent inclure l'étude des terres humides dans l'accord global visant l'élaboration des plans généraux pour l'aménagement des ressources en eau.

Le Ministère reconnaît la nécessité de soumettre les terres humides à une réglementation conjointe du gouvernement fédéral et des provinces et appuie fortement l'élaboration d'une politique des terres humides dans la province. Un des besoins les plus urgents est celui de mettre en place un système d'information destiné à démontrer au grand public le rôle important que jouent les terres humides dans l'équilibre écologique de la Nouvelle-Écosse.

La question des terres humides ne peut être traitée isolément. En effet, les activités qui se pratiquent sur les terres adjacentes peuvent avoir des effets très dommageables sur les terres humides mêmes. La question des zones tampons se présent. De meme, des nombreuses terres agricoles marginales protégées par des digues pourraient offrir un meilleur rendement si elles étaient rendues aux marais salants, ce qui pose le problème des conflits d'utilisation des terres. Ces observations ne visent qu'à illustrer le genre de problèmes qui ne peut être résolu par l'adoption de politiques ou de règlements axés sur un seul aspect. Un des moyens proposés pour assurer la prise en compte de toutes les

conséquences environnementales lorsqu'on étudiera l'aménagement futur des terres humides dans la province est la mise sur pied d'un comité consultatif intergouvernemental sur les terres humides.

Les sections régionales du ministère de l'Environnement seraient en faveur d'une approche conjointe fédérale-provinciale à l'élaboration d'une politique, d'une stratégie et d'une réglementation compatible visant la protection des terres humides de la Nouvelle-Écosse. Au demeurant, ces formes de collaboration à la gestion à long terme d'une bonne part des ressources côtières du pays seront examinées aux niveaux supérieurs des pouvoirs politiques et de l'administration au colloque sur la gestion du rivage du Conseil des ministres des Ressources et de l'Environnement, qui se tiendra en octobre 1980. Les mesures de collaboration qui seront arrêtées durant ce colloque pourront sans aucun doute servir à l'élaboration d'une politique sur les terres humides. En toute hypothèse, une consultation entre les autorités supérieurs des ministères intéressés permettrait de réaliser d'importants progrès communs dans ce domaine.

L'ÎLE DU PRINCE-ÉDOUARD

Dans le cadre d'un projet conjoint fédéral-provincial de l'Atlantic Provinces Soil Institute de Charlottetown, on procède actuellement à la cartographie des sols organiques et des formes de terrain. M. C. Veer, d'Agriculture Canada, a rédigé un rapport préliminaire sur les sols organiques de l'Île-du-Prince-Édouard (1978). Après sept années d'activités sur le terrain, on poursuit présentement l'établissement de 100 cartes à échelle de 1:10,000, dont l'achèvement est prévu pour la fin de 1980.

Dans son rapport, M. Veer a divisé les terres humides en un certain nombre de catégories aux noms évocateurs:

Plateau Bog (tourbière de plateau)
Flat Bog (tourbière plate)
Bowl Bog (tourbière en écuelle)
Channel Fen (tourbière de chenal)
Black Spruce Fen (tourbière à épinettes noires)
Brook Swamp (marais à ruisseau)
Vale Swamp (marais de vallée)
Telluric Swamp (marais tellurique)
Cedar Swamp (marais à cèdres)
Marsh Swamp (marais littoral)

Certaines de ces catégories diffèrent des catégories proposées par Charles Tarnocai pour le projet de registre des terres humides. Cependant, une analyse approfondie des définitions détaillées de la classification de M. Veer et l'analyse soumise aux commentaires généraux de Comité révèlent que ces différences sont d'ordre plutôt sémantique que théorique.

Dans l'Île-du-Prince-Édouard, les sols organiques ne font l'objet d'aucun mode d'exploitation agricole ou horticole. On n'y trouve qu'une petite entreprise commerciale de culture de la tourbe; nulle exploitation minière de tourbe combustible.

La Division des pêches et de la faune poursuit présentement un inventaire des terres humides de l'Île-du-Prince-Édouard. Cet inventaire est conçu dans une large mesure sur le modèle d'un programme analogue mis en oeuvre en Nouvelle-Écosse.

NOUVEAU-BRUNSWICK

Le représentant du Nouveau-Brunswick était absent. Un point à signaler au sujet du Nouveau-Brunswick, c'est l'expansion de l'industrie horticole de la tourbe dans cette province ainsi que les intérêts à utiliser cette ressource comme combustible et à vouer certains endroits à l'exploitation agricole. En réponse aux demandes visant l'utilisation multiple des terrains tourbeux, le ministère des Ressources naturelles a entrepris un inventaire détaillé des tourbières de la province. Il s'agit d'un inventaire continu grâce auquel 42% des tourbières de la province ont été recensées jusqu'au présent. Une superficie de 15,000 ha doit encore être inventoriée cette année.

QUÉBEC

Estaban Chornet a présenté un bref exposé en absence du membre du groupe de travail représentant le Québec. À l'heure actuelle, les utilisations horticoles et agricoles des terrains tourbeux suscitent le plus d'intérêt. Récemment, on s'est également intéressé au combustible de tourbe. Le gouvernement provincial entreprend un inventaire des tourbières de la région du bas Saint-Laurent dans le domaine de la culture intensive de la tourbe. Des échantillons obtenus lors de cet inventaire sont présentement analysés à Laval (propriétés horticoles) et à Sherbrooke (tourbe pour combustible).

L'Hydro-Québec a entrepris par l'entremise de l'Institut de recherche électrotechnique du Québec une série d'études sur le combustible

de tourbe. Il s'agit de déterminer les possibilités d'approvisionner en énergie la région du nord du Saint-Laurent. On a envisagé de construire dans l'Île d'Anticosti une usine expérimentale destinée à produire de l'essence à moteur diesel à partir de la tourbe.

L'Hydro-Québec a effectué des études de faisabilité dans la région du Saguenay en vue d'y installer une usine de 300 mégawatts. Aucun compte rendu n'a été fait des activités récentes touchant à la classification et aux recherches connexes.

ONTARIO

Le projet fédéral de la Direction régionale des terres, que Daryl Cowell et al ont décrit dans le compte rendu de la deuxième réunion du Comité canadien de la classification écologique du territoire est toujours en cours de réalisation. Ces travaux seront consacrés à certaines parties de la côte de la baie d'Hudson qui offrent un intérêt particulier au Service canadien de la faune puisqu'elles constituent d'importantes aires de nidification et de repos pour certaines espèces d'animaux migrateurs.

Walter Glooschenko, de l'Institut national de recherches sur les eaux, poursuit ses travaux sur les marais côtiers de la partie ontarienne des basses terres de la baie d'Hudson. (On trouvera plus de renseignements à cet égard dans le document de Dr. Glooschenko). La classification des marais côtiers demande à être raffinée dans la classification des terres humides du Canada (une catégorie de marais côtiers comparativement à 13 catégories de tourbières oligotrophes et 11 de tourbières minerotrophes). Il est important que le groupe de travail sur les terres humides collabore avec Dr. Glooschenko et d'autres chercheurs pour mener à bien cette classification des terres humides du pays.

À l'université de Guelph, le professeur Protz poursuit ses études sur la classification et la genèse des types de sol dans les basses terres de la baie d'Hudson et le professeur Martini étudie pour sa part les processus de sédimentation dans la même région. La connaissance des processus de développement des sols et de sédimentation est essentielle à la désignation descriptive des catégories d'une classification des terres humides du Canada.

Au Royal Ontario Museum, John Riley continue à ajouter des spécimens de plantes des basses terres de la baie d'Hudson à la collection du musée consacrée à cette région. Il poursuivra en outre des études sur la végétation pour les travaux sur le terrain liés au programme des terres humides du centre de télédétection de l'Ontario.

Ce programme, qui a été décrit par Pala et Boissoneau dans le compte rendu de la deuxième réunion du Comité canadien de la classification écologique du territoire, en est à un stade où environ 60% des travaux sur le terrain consacrés à la partie ontarienne des basses terres de la baie d'Hudson ont été effectués. Étant donné que leurs limites n'apparaissent pas clairement sur les images enregistrées par LANDSAT, les plaques reliques de l'ensemble des basses terres ont été délinéées à l'aide de photographies à échelle de 1:60,000 de la Photothèque nationale de l'air. La cartographie de ces basses terres du nord-ouest de l'Ontario sera achevée au cours de la saison d'activités 1979-1980. On procédera pour ce faire à l'extrapolation de nos données d'opérations à l'aide du système NORPAK RGP 3050 et d'un ordinateur PDP 11/34 qui serviront à l'analyse des bandes de LANDSAT à l'aide du logiciel ARIES conçu pour l'Institut d'aménagement forestier. Ce logiciel offre des possibilités de classification et d'accentuation. On a dressé les plans et a terminé les travaux préliminaires pour la saison de 1979 au cours de laquelle seront poursuivis les travaux sur le terrain dans les parties inachevées des basses terres ontariennes de la baie d'Hudson.

Le Canadian Field Naturalist continue à rendre compte des publications relatives aux terres humides et Boissoneau a récemment eu l'occasion de publier une analyse de certains concepts canadiens de classification des terres humides. Lors de la réunion annuelle de la Fédération des naturalistes de l'Ontario, qui s'est tenue au mois de mai, Steve Curtis, du Service canadien de la faune, a décrit les activités déployées par cet organisme pour l'acquisition des terres humides du sud de l'Ontario offrant de belles possibilités d'utilisation par les oiseaux aquatiques. La Fédération des naturalistes de l'Ontario s'apprête également à publier un numéro spécial du Ontario Naturalists consacré aux terres humides de l'Ontario. Outre les terres humides le long du lac Ontario qui ont été visitées pour la tenue de réunions sur le terrain de la Fédération des naturalistes de l'Ontario, dirigées par Mme Glooschenko et par des membres du Club des naturalistes de la région de Durham, les terres humides de la péninsule de Bruce ont également été au centre des réunions de la Fédération.

La Direction de la faune du ministère ontarien

des Ressources naturelles a étudié les systèmes de classification des terres humides de l'Amérique du Nord et a évalué les mérites relatifs de chacun dans leur application aux futurs programmes de la Direction consacrés aux terres humides. Cette étude recommande l'utilisation du cadre de classification des terres humides de Zoltai et al (1975).

Canards Illimités a des bureaux situés à London, Aurora, Kingston, dont l'effectif total est de 10 employés. Par ailleurs, on projette d'effectuer un inventaire des terres humides au sud de l'Ontario.

MANITOBA

La cartographie des sols organiques du sud du Manitoba se poursuit présentement dans le cadre de l'étude des sols du Manitoba. Le ministère des Ressources renouvelables participe au rassemblement d'ouvrages relatifs à des dépôts profonds de sphaigne qui pourraient être utilisés par l'industrie horticole.

Le marais Delta est le point de convergence des recherches sur les terres humides. Un comité consultatif technique formé de représentants des gouvernements provincial et fédéral a mis au point un plan d'aménagement du marais Delta. Sur une échelle moindre, la station de recherche sur les oiseaux aquatiques de Delta a mis sur pied, de concert avec Canards Illimités, un projet de 20 ans visant à aménager 20 étangs artificiels pour la recherche. L'eau des étangs sera maintenue à différents niveaux pour des périodes de temps variables et divers tableaux de recherche seront établis. La période de 20 ans commence cette année.

Canards Illimités entreprend dans toute la moitié sud du Manitoba un inventaire de toutes les terres humides d'une superficie dépassant 40 ha, qui devrait être achevé d'ici cinq ans. On a fait appel au système de classification de Millar pour la classification des types de terres humides. Les cartes établies sont à échelle de 1:50,000.

SASKATCHEWAN

Ce rapport traite uniquement de la partie méridionale de la province où se manifestent avec le plus d'évidence les conflits entre le milieu agricole et l'habitat de la faune. Les terres humides sont difficiles à aménager en fonction de la faune parce qu'elles appartiennent presque toutes à des propriétaires privés. Une partie de ces terres est vouée à la destruction par l'effet des activités de drainage et de brûlage. Le ministère du Tourisme et des Ressources renouvelables de la Saskatchewan poursuit, par l'entremise de la Habitat Protection and Development Division, un programme d'acquisition de terrains vierges. La Division s'est ainsi portée acquéreur de 20,000 ha de terres, une partie desquellès sont des terres humides. Elle s'occupe également de contrôler les activités d'aménagement agricole qui touchent à la faune. La Division de la recherche sur la faune poursuit un programme continu de cartographie portant sur l'aspect biophysique et sur le régime de propriété des terres.

Il existe au sein du Service canadien de la faune un modeste programme d'acquisition des terres humides. Millar y est chargé de l'étude de l'évolution des conditions de l'habitat.

L'inventaire des terres humides par Canards Illimités, qu'on avait signalé au Manitoba, se poursuit également dans l'ensemble de la Saskatchewan et de l'Alberta.

Le groupe de travail des terres humides de la Saskatchewan est composé de 14 membres représentant divers domaines tels que la foresterie, la faune, l'hydrologie, l'agriculture, les pêches et la pédologie. La discussion est surtout axée sur le besoin d'une classification pratique des terres humides des prairies. On pourrait adopter la classification de Millar ou en établir une nouvelle fondée sur l'expérience future et sur le contenu du registre des terres humides. Le groupe est intéressé à trouver des solutions aux proglèmes liés aux conflits entre l'aménagement agricole des terres et leur aménagement en fonction de la faune. On désire également mettre au point une classification des cours d'eau et normaliser la terminologie relative aux eaux des terres humides.

Un autre groupe qui participe activement à la recherche sur les terres humides est la Division du génie du Conseil de recherches de la Saskatchewan. Les activités de la Division ont été décrites en détail par J. Whiting et G. Lakshman dans ce compte-rendu.

ALBERTA

Le seul fait nouveau qui se rapporte aux terres humides c'est l'intérêt que porte le Provincial Forest Service à l'exploitation des tourbières dans le cadre d'un programme de drainage visant à accroître le volume des

récoltes forestières. Des membres du groupe de travail national donneront des conseils aux autorités provinciales sur la mise en oeuvre de ce programme. Les experts-conseils ont déjà entrepris un certain nombre de relevés biophysiques et d'évaluation des incidences. Un bon nombre de ces rapports contiennent des données sur les terres humides. Une autre source d'information est l'université de l'Alberta où se poursuivent des études sur la végétation des terres humides de cette province.

COLOMBIE-BRITANNIQUE

Un groupe de travail des terres humides de la Colombie-Britannique a été constitué par le Vegetation Functional Subcommittee du B.C. Land Resources Steering Committee. Le groupe de travail est composé d'environ cinq membres représentant les secteurs de la végétation, des sols et de l'hydrologie. Les membres ont généralement accès aux connaissances techniques propres à d'autres domaines, en particulier la faune, la gestion des pâturages et l'agriculture. Le groupe de travail a pour les objectifs premiers d'élaborer et d'appliquer un système de classification des terres humides de la Colombie-Britannique, qui soit fonctionnel et applicable à une grande variété d'usagers éventuels, ainsi que de coordonner l'inventaire des terres humides.

Une réunion importante s'est tenue en janvier 1978, à laquelle ont participé quelque 80 personnes représentant presque tous les organismes du gouvernement, les groupes industriels et les groupes d'intérêt privé qui s'intéressent aux terres humides. La réunion s'était fixée un certain nombre des objectifs dont le plus important était de déterminer l'identité des organismes et des personnes engagées dans des activités touchant aux terres humides; la nature des problèmes qui se posent; la nature des besoins des usagers d'un système de classification; et les positions actuelles quant à l'élaboration d'un tel système. Au départ, un des problèmes consistait à formuler une définition satisfaisante des terres humides. Les participants se sont finalement entendus sur la définition suivante:

> *Les terres humides sont des étendues de terrain suffisamment humides ou submergées assez souvent pour produire et entretenir une végétation naturelle particulière qui se distingue nettement de celle des terres adjacentes ou des étendues d'eau libre.*

Un des résultats importants de la réunion a été la création de cinq sous-groupes régionaux spéciaux et d'un sous-groupe chargé de vérifier les limites des régions des terres humides. Les sous-groupes régionaux étaient formés de 8 à 14 membres et se sont vu confier la tâche de déterminer: 1) la nature des besoins particuliers des usagers; 2) les types d'usagers, la nature des problèmes et des conflits courants, 3) le degré de précision nécessaire à la cartographie, à la collecte des données, etc., 4) la nature des exigences liées au schéma de classification imposé par les demandes des usagers et 5) d'établir les priorités de travail dans certains secteurs particuliers.

Les sous-groupes avaient un délai d'un an pour obtenir ces informations et préparer un rapport, après quoi ils seraient dissous.

En avril 1979, le groupe de travail des terres humides de la Colombie-Britannique et le président des sous-groupes se sont réunis pour mesurer les progrès accomplis et pour planifier de nouvelles activités. La valeur des résultats obtenus par les sous-groupes variait de très bonne à essentiellement nulle. Des problèmes ont été posés par l'absence d'un mandat clair permettant aux membres des sous-groupes d'opérer de manière satisfaisante, en particulier dans les régions de la Colombie-Britannique où l'importance accordée aux activités du domaine des terres humides est particulièrement faible. Une recommandation a été formulée au B.C. Land Resources Steering Committee en vue d'apporter un remède à cette situation.

Il a fallu restructurer le groupe de travail des terres humides en vue de combler les postes laissés vacants à la suite des changements apportés à l'effectif du personnel de nombreux organismes du gouvernement. Le nouveau groupe est formé de Tom Chamberland (hydrologiste), Herb Luttmerding (sols) et Jim van Barneveld (végétation) du ministère de l'Environnement de la Colombie-Britannique, Al van Ryswyk (gestion des pâturages) d'Agriculture Canada et Ed Oswald (président) du Service canadien des forêts.

Les sous-groupes régionaux ont également été remaniés, leur nombre réduit à quatre et leurs objectifs redéfinis. Ces groupes et leurs présidents sont les suivants: 1) Boreal-Peace, Howard Slavinski, Agriculture Canada, 2) Boreal-Cariboo, Marty Beets, ministère des Loisirs et de la Conservation de la Colombie-Britannique, 3) Coast Mountains, Jim Pojar, ministère des Forêts de la Colombie-Britannique, et 4) Coast Marine, Bruce Pendergast, ministère des Loisirs et de

la Conservation de la Colombie-Britannique. Voici quels sont les nouveaux objectifs de ces sous-groupes: a) déterminer les besoins relatifs à un système de classification à partir des caractéristiques des usagers de la région, b) évaluer la capacité des systèmes existants ou de certaines parties de ces systèmes de répondre aux exigences et c) mettre en lumière les situations ou les secteurs épineux qui requièrent une attention particulière. On a également demandé que le président du sous-groupe régional participe aux réunions du groupe de travail des terres humides de la Colombie-Britannique.

Notre premier objectif demeure l'élaboration et l'application d'un système de classification des terres humides de la Colombie-Britannique qui soit compatible avec le système national, propre à répondre aux besoins des usagers et à être appliqué par divers employés itinérants. Il s'agit d'étudier et d'éprouver les systèmes de classification pour déterminer dans quelle mesure ces systèmes ou certaines parties d'entre eux répondent aux exigences. Les éléments du système et les modifications de ces éléments seront regroupés périodiquement pour former une approximation unifiée du système de classification des terres humides de la Colombie-Britannique. On se propose de franchir un premier pas dans cette direction lors d'une réunion prévue pour cet automne.

À l'heure actuelle, d'importantes sujets de préoccupation se posent dans la région de Cariboo-Chilcotin où l'on trouve une grande étendue de terrains intermédiaires entre les terres humides et les prairies sèches, ainsi que dans les environnements côtiers auxquels ne s'applique qu'une faible partie des systèmes de classification existants. Le pâturage, l'agriculture et la faune se disputent l'utilisation des prés de la région de Cariboo-Chilcotin et un système de classification s'impose qui permette d'en déterminer le mode d'utilisation optimal. Ces prés se trouvent souvent à la limite des terres humides et ne sont pas traités de façon satisfaisante par les systèmes actuels. Des problèmes de classification se posent pour les zones qui ne sont submergées qu'une partie de l'année, surtout si le niveau de submersion varie d'une année à l'autre. On les inclut dans la catégorie des marécages, mais les divisions de niveau inférieur se voient attribuer des caractéristiques qui ne correspondent peut-être pas à la définition d'un marais; on a per conséquent tendance à placer les prairies au même niveau que les marécages.

Dans les milieux côtiers, de nombreux problèmes se posent, parmi lesquels la présence de terres humides sur les terrains rocheux disposés en pente. Ces terres peuvent prendre l'allure de tourbières oligo- ou minerotrophes, mais sans la profondeur de matières organiques associée à ces catégories. La régularité avec laquelle on les retrouve dans le milieu ainsi que l'absence de critères marqués sont à l'origine de désignations telles que tourbières oligotrophes-minérotrophes (bog-fen). Ces tourbières se retrouvent sur les pentes colluviales ou morainiques exposées à des précipitations abondantes (quelque 2000 mm ou plus), et sur lesquelles s'écoule une grande quantité d'eau de ruissellement. La composition de la végétation varie d'une zone à l'autre, mais on y trouve habituellement des arbres, des arbrisseaux, des herbes et de la mousse en quantités variables.

On étudie présentement la possibilité de dresser un registre des catégories de terres humides, comportant une description exhaustive de terrains répondant dans une large mesure aux critères formels correspondant à chaque catégorie du système de classification. Il ne s'agit pas de reproduire le registre national des terres humides, mais plutôt de fournir un ouvrage de référence aux personnes consacrées à la classification et à l'inventaire des terres humides dans la province. La plupart des employés itinérants ont adopté les formules de données relatives aux sols et à la végétation, qui ont été préparées par la Resource Analysis Branch du ministère de l'Environnement de la Colombie-Britannique pour l'introduction dans les fichiers mécanographiques des données recueillies sur le terrain. La plupart des données nécessaires aux descriptions des terres humides sont enregistrées sur ces formules, saut peut-être certains paramètres hydrologiques. Les informations obtenues grâce à ces formules formeront sans aucun doute la base du premier registre, ce qui évitera d'élaborer un nouveau système d'analyse des formules et des données. La possibilité existe sans doute de reproduire sur imprimante les deux formules en même temps et ces reproductions pourront être obtenues sur demande. La version définitive consistera probablement en une description exhaustive du type de terres humides, des variations admissibles dans chaque paramètre, des diagrammes schématiques et des photographies aériennes et au sol. Ce document pourrait ensuite être annexé au système de la classification.

National Wetlands Working Group
Second Meeting
June 11-13, 1979 Saskatoon, Saskatchewan

AGENDA

Monday June 11:

Morning: Business Session

9:00	(1) Opening Remarks by Chairman	F. Pollett
9:30	(2) Presentation of Updated Wetland Region Map for Canada	S. Zoltai
10:30	(3) (a) Presentation of Peatland Registry Guidelines	C. Tarnocai
12:15	Lunch	

Afternoon: Business Session

13:30	(3) (b) Examples of Application of Guidelines	
	i) Blanket Bog - Newfoundland	D. Wells
	ii) British Columbia	E. Oswald
14:30	(4) Provincial Reports	F. Pollett H. Hirvonen S. Chornet A. Boissonneau G. Adams C. Tarnocai E. Oswald

Tuesday June 12:

Morning: Business Session

9:00	(5) Canadian Symposium on Ecology of Wetlands	F. Pollett J. Shay
11:00	(6) Potential of Using Peat for Energy Production in Canada	S. Chornet
12:00	(7) Audio-visual Presentation on Peatlands of Newfoundland	F. Pollett D. Wells
12:30	Lunch	

Afternoon: Seminar on Classification and Use of the Wetland Resource

13:30	(8) U.S. National Wetland Classification with Possible Applications to Wildlife Habitat	L. Cowardin
14:00	(9) Wetland Vegetation - An Ecological Rediscovery	G. Lakshman
14:30	(10) Stream Classification for Habitat Mapping	J. Whiting
15:00	(11) Canadian Salt Marshes - With Emphasis on Subarctic Varieties	W. Glooschenko
15:30	Concluding Remarks	F. Pollett

Wednesday June 13:

Morning: Field Trip

This shall involve a two-hour aerial sortie over eastern Saskatchewan to view representative prairie wetland types and conservation practices. The aircraft will fly southeast over Little Manitou Lake and Last Mountain Lake; east to the Touchwood Hills and Indian Reserves; north over Big Quill Lake, Lenore Lake and the Waterhen Marsh; then southwest along Wakaw Lake back to Saskatoon. Guides from the Canadian Wildlife Service and Duck's Unlimited will be available to point out wildlife control structures (such as dams and impoundments) and to answer questions.

Afternoon: Field Trip

This trip will be conducted using automobiles to allow on-site investigation of about ten different wetland types southeast of Saskatoon. Field gear including hip-waders will be required. Vehicles and guides will be provided by the Canadian Wildlife Service, Duck's Unlimited and the Saskatchewan Wildlife Service.

Groupe de travail des terres humides
Deuxième Réunion
11-13 Juin, 1979 Saskatoon, Saskatchewan

ORDRE DU JOUR

Lundi, 11 juin:

Discussions

9 h 00	(1)	Ouverture par le président	F. Pollett
9 h 30	(2)	Présentation de la carte à jour des régions à terres humides du Canada	S. Zoltai
10 h 30	(3)	(a) Présentation des directives relatives à l'enregistrement des tourbières	C. Tarnocai
12 h 15		Dîner	
13 h 30	(3)	(b) Exemples de l'application des directives i) Tourbière à couches de Terres-Neuve ii) Colombie-Britannique	 D. Wells E. Oswald
14 h 30	(4)	Rapport provinciaux	F. Pollett R. Hirvonen S. Chornet A. Boissonneau G. Adams C. Tarnocai E. Oswald

Mardi, 12 juin:

Discussions

9 h 00	(5)	Symposium canadien sur l'écologie des terres humides	F. Pollett J. Shay
11 h 00	(6)	Possibilités d'utiliser la tourbe comme source d'énergie au Canada	S. Chornet
12 h 00	(7)	Présentation audio-visuelle sur les tourbières de Terre-Neuve	F. Pollett D. Wells
12 h 30		Dîner	

Discussions sur la classification et l'utilisation des terres humides

13 h 30	(8)	Le système national de classification des terres humides aux Etats-Unis et ses applications possibles aux habitats fauniques	L. Cowardin
14 h 00	(9)	Végétation des terres humides - redécouverte écologique	G. Lakshman
14 h 30	(10)	Classification des cours d'eau pour la cartographie des habitats	J. Whiting
15 h 00	(11)	Marais salants du Canada - en particulier les variétés subarctiques	W. Glooschenko
15 h 30	(12)	Conclusion	F. Pollett

Mercredi, 13 juin:

Excursion (avant-midi)

Deux heures de vol au-dessus de l'est de la Saskatchewan pour observer des types caractéristiques de terres humides des prairies et les pratiques de conservation utilisées. On se dirigera vers le sud-est, au-dessus du lac Little Manitou et du lac Last Mountain; vers l'est, sur les Collines Touchwood et les réserves indiennes; au nord sur le lac Big Quill, le lac Lenore et le marais Waterhen; ensuite, vers le sud-ouest, au dessus du lac Wakaw, et de retour à Saskatoon. Il y aura des guides du Service Canadien de la Faune et de Canards Illimités pour indiquer les ouvrages de retenue des eaux pour la faune (par exemple, des barrages et des bassins) et pour répondre aux questions.

Excursion (après-midi)

La randonnée se fera en autom de façon à ce que l'on puisse examiner environ dix types différents de terres humides, au sud-est de Saskatoon. Il faudra un certain équipement, entre autres, des cuissardes. Les véhicules et les guides seront fournis par le Service Canadien de la Faune, Canards Illimités et le Service de la Faune de Saskatchewan.

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